Centre for Distance Education
Acharya Nagarjuna University

Nagarjuna Nagar-522 310, Andhra Pradesh.

DR. (SMT.) G. BHUVANESWARA LAKSHMI
M.Sc., M.Ed., Ph.D.,
Principal, Montessori Mahila College of Education,
Vijayawada – 520 010

CERTIFICATE

This is to certify that the dissertation of ***Mr. K. Rama Krishna*** on

'A STUDY OF THE ORGANISATION OF MATHEMATICAL CO-CURRICULAR ACTIVITIES IN SECONDARY SCHOOLS'

Submitted for the Degree of **Master of Philosophy in Education,** Centre for Distance Education, Acharya Nagarjuna University is

- a genuine work of the scholar
- of the standard expected of a Thesis for the M.Phil degree
- not substantially the same as any thesis submitted to any other University

and

- is satisfactory in respect of literary presentation as well as in other respects and is in a form suitable for publication.

The investigator has worked right through under my guidance and supervision.

Place: Vijayawada **DR. (SMT.) G. BHUVANESWARA LAKSHMI**

Date: **Research Director**

DECLARATION

I hereby declare that the dissertation entitled

'A STUDY OF THE ORGANISATION OF MATHEMATICAL CO-CURRICULAR ACTIVITIES IN SECONDARY SCHOOLS'

Submitted for the Degree of **Master of Philosophy in Education,**

Centre for Distance Education, Acharya Nagarjuna University

is an original Research work done by me under the guidance of

Dr. (Smt.) G. Bhuvaneswara Lakshmi, **M.Sc., M.Ed., Ph.D**

Principal, M.M. College of Education, Vijayawada–520 010.

This work has not been submitted either in full

or in part for any degree at any other University

Place: Vijayawada K. Rama Krishna

Date: The Research scholar

ACKNOWLEDGEMENTS

On the eve of the submission of this thesis,

the investigator with great pleasure wishes to acknowledge his gratitude first and foremost to **Dr. (Smt.) G.Bhuvaneswara Lakshmi**, **M.Sc, M.Ed., Ph.D.,** Principal, Montessori Mahila College of Education, Vijayawada, for her valuable guidance and suggestions. She was always cheerful and encouraging when approached and this propelled the investigation to its successful completion.

The investigator solicits his deep sense of gratitude to **Prof. D.S.N. Sastry, M.Sc., M.Ed., Ph.D,** Department of Post Graduate Studies, Vikas College of Education, Vissannapeta, who educated the investigator in the real sense of the word, for his valuable and thought provoking suggestions, and help and kind cooperation in all possible ways throughout this work.

The investigator is indebted to his teacher, **Sri P. Satyanarayana Sarma**, **M.Sc., M.Ed., M.Phil.,** Senior Teacher in Mathematics, Sisuvidyamandiram High School, Vijayawada-11 for the keen interest shown, co-operation and help done right from the selection of this research topic till its end.

The investigator is thankful to **Sri. B.V.L. Narasimha Rao;** Lecturer in Psychology and other colleague staff members of S.R.S.V. College of Education, Vijayawada-3 for their heartfelt cooperation accorded to carry out this piece of research work. The investigator's thanks are due to the teachers of the 111 secondary schools, who extended their cooperation in the administration of the tool.

The Investigator

A STUDY OF THE ORGANISATION OF MATHEMATICAL CO-CURRICULAR ACTIVITIES IN SECONDARY SCHOOLS

CONTENTS

LIST OF TABLES

CHAPTER – I
THE PROBLEM AND ITS SIGNIFICANCE

Research problems do not exist in nature. They are not part of the objective world. Problems arise in the minds of the people; they arise because of knowing, reflecting, and questioning. It is the curiosity about the unknown that makes one aware of the need to know, to find out, to understand, and to be able to explain and to predict.

--- Padmakar, M.S.

1.1. INTRODUCTION

Co-curricular activities may not be tested or graded, but they educate and benefit-students in ways that classroom activities cannot.

--- Edward J. Klesse and Jan A. D'onofrio

The function of education is to bring change in child behavior and personality in a more desirable form. Development of child's body and mind demand proper nurturing of its physical and intellectual qualities as few of the major determinants of his personality. Therefore, modern approaches of education emphasize on all round development of the child.

The process of education is not something static or one time measure rather, continuous and life long endeavor that can be divided in to two parts; curricular activities and co-curricular activities. These are recognized as a source of enrichment and vitalization of the school curriculum, mainly through the cultivation of hobbies, interests, etc. These activities are no longer looked upon as extras but as an integral part of the school programme. The distinction between curricular and co-curricular is gradually disappearing in modern educational practice and the coordination and integration of all the experiences of the pupils' intellectual, social, moral, emotional and physical abilities has become the object of the persistent efforts of the school.

Co-curricular activities, as the name implies, are those, not directly related with the prescribed curriculum and include; sports, athletics, scouting, cubing, various hobbies, excursions, literary societies, dramatics, debates etc. to bring social and physical adjustments in the child. The basic idea behind such activities in educational institutions is the building up of the student character and personality as well as training of their mind that may help / facilitate academic achievement of the child.

Co-curricular activities help to develop the all-round personality of the students to face the undaunted task and turbulent world of future. The aim of co-curricular activities is to make the students fit for the future time and to develop a sense of competitive spirit, co-operation, leadership, diligence, punctuality, and team spirit as well as to provide a backdrop for the development of their creative talents.

1.2. IMPORTANCE OF MATHEMATICS

'Mathematics' is a universal subject discipline. Mathematics should be visualized as a vehicle to train a child to think, reason, analyze and to articulate logically. Apart from being a specific subject, it should be treated as concomitant to any subject involving logic and reasoning.

--- National Policy on Education, 1986.

Mathematics - in a strict sense is the abstract science which investigates deductively the conclusions implicit in the elementary conception of spatial and numerical relation. Many mathematicians made India proud with their research and contributions in the field of mathematics. It is a fact that the world requires more number of mathematicians to do its work. Modern world is dependent on the applications of mathematics. Without mathematics the earth could not have supported the present population. In fact all the research work in any field of science depends on the basic concepts of mathematics. It is acting as a basic science which is not merely equipped with formulae and theories, but also with solutions and suggestions. In every profession or science knowledge of mathematical concept is essential. Thinking process and the logical ways of solving a problem are the fruits of mathematics.

Human civilization reveals the necessity of mathematics in all aspects. Qualitative sciences become quantitative because of the progress in mathematics. Comfort, Convenience and progress are required in mathematical knowledge skill in planning and designing in productions or even estimating and evaluation have become integral part of the life.

There is no science, no art and no profession where mathematics does not hold a key position. The accuracy and exactness of science is determined by the amount of mathematics utilized in it. Even social sciences like economics, psychology, geography etc., make good use of mathematics. Infact, mathematics was invented and devised as an instrument for the purpose of investigation, understanding and formulating properties of natural phenomena both physical and social.

Guilford says *the progress and maturity of a science are often judged by the extent to which it has succeeded in the use of mathematics. Every phase of the daily experience offers an opportunity to develop some aspects of mathematical competence, because mathematics is a social study, a language, an aesthetic art and a recreational activity.*

There is beauty, rhythm, symmetry and order in mathematics. These qualities are translated into fine arts. So, we enjoy mathematical recreations and solutions of problems in mathematics as we enjoy dance, music and other fine arts. The essential characteristics of Mathematics like accuracy, truthfulness, honesty of pursuit when integrated in the molding of individuals can play vital role in bringing up true democratic citizens.

Napoleon pointed out the importance of mathematics as *'the progress and the improvement of mathematics are linked to the prosperity of the state'*. The Education Commission (1964-66) stressed the importance of mathematics in relation to education and research. The commission recommended that *deliberate efforts should be made in making citizens mathematically competent. Therefore the teaching of Mathematics assumes a very important role in school situation.*

In the first study of the International Mathematics, (U.S.A.) it is estimated that one fifth of student's time is devoted to Mathematics alone. Even from the individual point of view, knowledge of Mathematics is needed for preparation for adult life and for career choices. From the social perspective, Mathematics competency is firstly an essential component in the preparation of an informed citizenry and secondly it is needed to ensure the continued production of skilled personnel required for the society.

1.3. STATUS OF MATHEMATICS AS ON TODAY

The main goal of mathematics education in schools is mathematisation of the child's thinking clarity of thought and pursuing assumptions to logical conclusions is central to the mathematical enterprise. There are many ways of thinking one learns in mathematics is an ability to handle abstractions, and an approach to problem solving.

---National Focus Group on Teaching of Mathematics, 2006

Knowledge of mathematics is a social necessity. It possesses a lot of practical value. Mathematics as a discipline can promote systematic and orderly habits which increase respect for truth and honesty. In this way mathematical knowledge can develop a true character in any individual. *Comte (1964)* stressed mathematics as the foundation of Scientific Education. The acquisition of mathematical knowledge and its effective use when viewed through its status as on to day reveals the following points. These can be comprehended as follows

- To enable the students to appreciate the past played by mathematics in the development of civilization.
- To develop original thinking and reasoning power of students.
- To provide Mathematical knowledge required in day to day life and various vacations. This type of knowledge will prepare the child for successful participation in life.
- To prepare the child for taking up various professions. He should be enabling to earn his livelihood.

- To make use of Mathematical principles in all fields whether engineering, agriculture, accountancy, shop keeping etc.
- To promote habits of effective thinking.
- To develop intellectual independence.
- To develop cultural advancement.
- To recognize its responsibility for the events of instruments such as adding machines, computers etc.
- To stress the need of good mathematical back-ground for any person in the present age of rates, taxes, insurance, savings and interests rents and propaganda.

1.4. MATHEMATICS AS COMPULSORY SUBJECT

From ancient times in different civilizations it is observed that mathematics was made compulsory. *Vedic*, *Buddha* and *Jain* mathematics stressed its importance. ***'Vedaangajyotisha'*** (1100 B.C.) ranked ***Ganitam on top of all Vedaangas*** (*Ganitam Murdhanisthitam*). *Gowtam Buddha* and *Mahavera* were good at mathematics. Books on Jain philosophy made mathematics compulsory by calling it as ***'Yoga'.*** There is an old saying in Tamil that ***'Numbers and alphabets are two eyes'***.

'Mathematics is the only subject that encourages and develops logical thinking. It helps the student to discriminate between the essential and non-essential. It helps them soft facts draw conclusions compactly and without ambiguity and thus it is a subject by which they may learn what is meant by rigid reasoning'. *--- Young*

Mathematics is the only subject that exercises the reasoning power more and claims memory less. It is to enable the student to think accurately. So, the mathematical reasoning cultivated in the student is entirely original and not the reproduction of the ideas previously read or heard. This originality gives the student, confidence and power to face the problems in real life, which may arise in future. Mathematics helps to promote not only logical thinking but also clarity of thought and concentration. It also develops the attitude of discovery in the pupil.

The National Policy on Education 1986 (N.P.E.) emphasized the importance of Mathematics education in our schools. N.C.E.R.T., at the national level and S.C.E.R.T. / S.l.Es., at the state level had initiated several steps to improve the quality of Mathematics education in our schools. The Associations of Mathematics Teachers at the National level (Association of Mathematics Teachers of India, for example) and in various states are doing very useful work. But ultimately it is on the classroom Mathematics teacher, that everything depends. Every Mathematics teacher can do a lot in his / her own way, to make the learning of Mathematics more enjoyable, leading to the qualitative improvement of Mathematics education in our schools.

As the secondary school has obligation to provide pupils with opportunities to explain widely their life, it should contain mathematics as one of the compulsory subjects in its curriculum. The importance of mathematics in the real world should be reflected in the secondary schools. It should preserve and propagate the right place of mathematics as it is one of the compulsory subjects of secondary education. It is said that, ***'Mathematics and languages are meat and potato of the educational diet of the people'.***

1.5. PLACE OF MATHEMATICS IN SCHOOL CURRICULUM

The claim of any particular branch of natural philosophy to be considered as a science can be assessed only on the basis of the amount Mathematics employed in it. *--- Comte*

Of all the subjects in the school curriculum mathematics occupies a central place and it serves as a touch-stone to know the climate of learning that prevails in a school. If any subject can be most ill – taught, it can be only mathematics. Among the subjects in the school curriculum, mathematics gets the least environmental support. A majority of the children find mathematics learning dry and artificial as it is not related to their environment. Mathematics is still not taught as an exploratory and experimental subject to help students learn mathematics with confidence and conviction. The teachers and parents should share and join hands to provide this environmental underpinning.

For solving problems one requires thinking. Mathematics develops thinking to a maximum extent when compared to other curricular subjects. We solve problems in mathematics classrooms whether they are related to the daily life or not. Mathematics is useful in very walk of every individual. Hence the place of mathematics in curriculum is crucial and important.

The National Committee on Mathematical Requirements, (U.S.A.-1927) reported that *'the primary purpose of teaching mathematics should be to develop those powers of understanding and of analyzing relationships of quantity and space which are necessary to have an insight into and control over our environment and to have an appreciation of progress of thought and of action which will make these powers effective in the life of the individual'*.

To meet these demands, the teaching of mathematics in Secondary Schools should, therefore, reflect the social utility, habit formation, mental discipline and ability to make decisions. Mathematics teaching in Secondary Schools can cultivate certain systematic and orderly habits which increase respect for truthfulness and honesty. Mathematics as an expression of human mind reflects the active will, the contemplative reasoning and the desire for aesthetic perfection. One of the outstanding characteristics of scientific culture is quantification. Mathematics, therefore, occupies a prominent position in modern education ultimately in secondary curriculum.

1.6. IMPORTANCE OF TEACHING MATHEMATICS AT SECONDARY SCHOOL LEVEL

All scientific education which does not commence with mathematics is of necessity, defective at its foundation. *- Comte*

Mathematics has been made a compulsory subject at the secondary level with the hope that it will inculcate some minimum basic skills to every future citizen of the country to ensure their future happy life.

The reason for the important place of mathematics at secondary school level is, without the knowledge of mathematics a person will be unable to cope with his day to day life as he has to apply it in each and every aspect such as agriculture, health, household accounts, measurement etc.

Srinivasan, P.K. (1992) in the annual conference of the A.M.T.I. at Delhi sadly felt that … ***Students by and large know mathematics only as an exam passing subject for which they are coached to answer set questions in a set manner without opportunities for insightful and creative involvement in learning process require growth in mathematical way of thinking. So the need to popularize mathematics cannot be dismissed light-heartedly by saying that if one wills it, it can be done easily. Popularization can not be achieved by bringing the class room on the screen with some back-ground music.***

Mathematics occupies a central place in the curriculum and it is next to on1y the 1anguages in importance. This has been so from times immemorial. Even in ancient schools of Greece, India, China, Mathematics teaching and learning was given a prominent place. But, as the age is going on this place came down.

In Service Teacher Education Package, Module 27 stated that the teaching of mathematics in majority of the schools is far from satisfactory. The rate of failures in mathematics is considerably higher than in other subjects. Many pupils find mathematics a difficult subject whatever be the reason for this attitude.

As *Srinivasan, P.K.* (1981) said in his book entitled *'Why maths club?'*… Mathematics continues to widen its frontiers of abstraction and application at an astoundingly fast rate with its geometries, algebras and arithmetic and their inter disciplines. This is the golden age of mathematics which has witnessed the advent of the computer representing as it does in all its glory and grace the narrowing gap between abstraction and application.

The increasing employment of mathematical tools in Hitherto and undreamt of fields of human endeavor like biology, economics, sociology, business management, etc has dramatized its importance in school curriculum.

1.7. OBJECTIVES OF TEACHING MATHEMATICS

The objectives of teaching mathematics can be listed as follows.

- Acquiring knowledge and understanding of the terms, concepts, principles, processes, symbols and mastery of computational and other fundamental processes those are required in daily life and for higher learning in Mathematics.
- Developing skills of drawing, measuring, estimating and demonstrating.
- Applying mathematical skills to solve problems that occur in daily life as well as problems related to higher learning in mathematics or allied areas.
- Developing the ability to think, reason, analyze and articulate logically.
- Appreciating the power and beauty of mathematics.
- Shows an interest in competitions of mathematics by participation in mathematical competition and engaging in its learning
- Developing a reverence and respect towards great mathematicians particu1ar1y towards the great Indian mathematicians for their contribution to the field of mathematics.
- Develop necessary skills to work with modern technological devices such as Calculators, Computers etc.

The objectives of mathematics teaching as given by *Butler and Wren (1960)* are

- Competence in the basic skills of understanding for dealing with number and form.
- Communication through symbolic expression and graphs.
- Development of ability to distinguish between relevant and irrelevant data.
- Development of intellectual independence and aesthetic appreciation.
- Development of ability to make relevant judgment through the discrimination of values.
- Development of cultural advancement through a realization of the significance of mathematics in its own right and in its relation to the physical and social structure.

The *National Policy on Education, 1986 (N.P.E.)* identified strengths and weaknesses of the system of education and clearly enunciates the direction for re-shaping the system at school level. There is a specific mention in the it about mathematics education in the following words-'*Mathematics should be visualized as a vehicle to train a child to think, reason, analyze and articulate logically apart from being a specific subject'*.

1.8. PROBLEMS IN TEACHING OF MATHEMATICS

Some teachers cannot emancipate themselves from long established habit of providing descriptive information, prolonged explanations to students to the point of warping the perspective deviating from the focus and depriving the students the opportunity to exercise their intellectual abilities.

--- Taba

Man is faced by problems which must be met and solved. These problems are as varied as life itself. The mathematics teacher has no exception. In fact his problems are more complex. The society may not appreciate the role played by him. The parents of the pupils may be indifferent to what is happening in the mathematics class-room.

The administrative difficulties are numerous. The un-widely class -room size, the noisy class-rooms and un-hygiene surroundings are detrimental to the progress of mathematics teaching. Periodic absence of some pupils and late coming are some of the factors that disturb the continuity of mathematics programme. Some times the curriculum of mathematics itself is a major obstacle in the teaching of mathematics.

Extensive reading and the habit of consulting reference books on the part of teachers as well as pupils is completely absent in our schools situation. The textbooks do not contain investigatory projects and other challenging material to cater to the individual needs of gifted pupils. Organizing practical work is almost impossible in our schools.

The very important role of a teacher to promote nation building activities is very much restricted, though the Education Commission (1966) mentioned *'Of all the different factors which influence the quality of education and its contribution to national development, the quality, competence and character of teachers are undoubtedly the most significant'.*

National Focus Group on Teaching of Mathematics in his *Position paper (2006)* stated that *'we note that a great deal needs to be done towards preparing teachers for mathematics education. A large treasury of resource material, which teachers can access freely as well as contribute to, is badly needed. Networking of school teachers among themselves as well as with University teachers will help.'* The focus group further expressed that *'mathematics education in our schools is best with problems. We identify the following core areas of concern*

- *a sense of fear and failure regarding mathematics among a majority of children*
- *a curriculum that disappoints both a talented minority as well as the non-participating majority at the same time*
- *crude methods of assessment that encourage perception of mathematics as mechanical computation, and*
- *lack of teacher preparation and support in the teaching of mathematics*

One general problem which is frequently noticed in a typical class-room is teachers rushing to the assistance of the students at the first sign of difficulty and virtually doing the work. Plans to incorporate into instructional programme, opportunities to discover and learn are very rare. This makes the learning a very difficult, uninteresting and monotonous work to the learner.

The inherent abstractness of the grand subject mathematics makes it less attractive to an average learner. Further, mathematics demands more hypothetical situations which young students cannot realize in a class-room. This makes the subject altogether difficult.

1.9. IMPORTANCE OF CO-CURRICULAR ACTIVITIES IN MATHEMATICS

Learning how to use mathematics curriculum materials (Co-curricular activities) to create learning opportunities is an important part of the work of teaching. Curriculum materials are important and can be influential resources for teachers. Mathematics curriculum materials, in particular, are potentially influential given the challenging nature of mathematics instruction espoused under recent reform efforts.

--- Alison M. Castro

One of the challenging tasks for a teacher of mathematics is to create and maintain interest among his students. Students, in mathematics classes, easily lose interest and show signs of restlessness. Perhaps, it is one of the most difficult problems encountered by the teachers of mathematics.

It is a well known fact that the students will work most diligently and effectively on tasks in which they are genuinely interested. Interests are motives which serve as important influences in producing both activities and attitudes that are most favorable for learning. A strong interest in mathematics tends to enhance the desire to learn mathematics in a more productive way.

A resourceful mathematics teacher can make use of a good number of methods and techniques for arousing and sustaining interest in mathematics. Learning mathematics in an informal way through recreational and fun filled activities is an important means of non formal mathematics education. Mathematics provides ample opportunities for fun and recreation. Mathematical games and puzzles open up avenues for learning mathematics in a lucid and relaxed manner. The teacher of mathematics can provide a variety of unfilled activities that could sustain the student's interest and promote student's mathematical learning. Such methods include

- Organizing mathematics club
- Organizing mathematics fairs
- Emphasizing aesthetic nature of mathematics

Malathi, K.N. (1993) in her talk in the silver jubilee conference of the A.M.T.I. at Madras felt that --- *I read a little book entitled "Figure for fun" by a Russian author Y.Pereleman. As I read through it enthralled, I thought that... 'This couldn't be mathematics' and I found myself being gradually drawn in to the world of recreational mathematics and with out knowing it in to the world of real mathematics. However, it is difficult to exactly quantify how much this influenced me to take up engineering which is full of applied mathematics, but I do believe that it must have played a significant role.*

The pedagogic value of co curricular activities in mathematics is now widely recognized and one finds an increasing emphasis of it in magazines for mathematics teachers and in newer text books. These activities can create an exciting workshop atmosphere for learning where the child participates very actively in discovering and creating findings for him / her self by experimental methods. To master any thing involves effort, but it need not involve unpleasant effort or drudgery.

1.10. OBSTACLES FOR CONDUCTING CO-CURRICULAR ACTIVITIES IN MATHEMATICS

Mathematics as an art form lends itself to dramatization, field events, story telling, blending of patterns and designs with music and dance etc with tremendous appeal to aesthetic sense in man.

--- Srinivasan, P.K.

It is a well known fact that for the success of any activity, co-ordination among different aspects / components of the activity is a must. The same is the case with conducting co-curricular activities in mathematics also. Starting with the knowledge of planning an activity till getting feed-back of the programme, a number of obstacles influences the success rate of the activity. Conducting co-curricular activities in mathematics needs, not only the physical / financial assistance, but also the subject depth of the teacher / organizer of the activity. Mathematical co-curricular activities require natural curiosity and imagination on the part of the organizers.

Srinivasan, P.K. (1992) in his talk at the annual conference of the A.M.T.I. at Delhi felt that --- *what an unfortunate thing to observe that mathematics teachers are often least knowledgeable about the developments in the fields of mathematics and its applications, mathematics education and its strategies. Mathematics teachers believe that their job is done if they prepare students to pass examinations and this belief is fostered by the sociological climate prevailing today. The teachers continue to impoverishing generations of students and hence the strength and welfare of the country Innovations that are breathe of progress and growth in any profession to day is almost ignored by the mathematics teachers in our country.*

He further in his book **'Why Maths Club?'** opined that --- *mathematics progress is in terms of conceptual clarity, grater abstraction and newer application which mostly the university men of mathematics can alone be expected to know. Neither do the school teachers, by and large, get the urge or feel the pressure to know these tremendous developments in mathematical thought nor are they given opportunities to get exposed to them.*

He further expressed that *only a few interested teachers, how ever, maintain through private study and reflection their zeal for learning new things, teaching in new ways and transmitting new trends for the sheer joy of seeing children enjoy themselves through intellectual adventures. The influence of such teachers needs to allow spreading my means of a built in mechanism in the functioning of the schools and colleges. There is stir and ferment in the atmosphere of learning mathematics in schools all over the world and it needs to be channeled in to constructive and creative endeavors so that mathematically gifted children could be detected and taken care of early. As one who has arranged more than 40 mathematics expositions, most of them being exclusively ones, I can assert with-out any fear of contradiction that a mathematics exhibition can be held under all circumstances, provided the teacher is deeply interested in getting children involved in a creative activity and is keenly aware of its educational value.*

Sarma, P.S.N. (2009) expert in conducting co-curricular activities in mathematics in an oral interview with the investigator, expressed the following as the obstacles for conducting co-curricular activities in mathematics:

- Lack of curiosity, attitude and imagination of the teacher
- Lack of resourcefulness and initiation of the teacher
- Lack of moral support from school management and colleagues
- Lack of familiarity with the knowledge of co-curricular activities
- Insufficient financial sources
- Low level of interest shown by the students
- Non co-operation from parents' side
- Non availability of resource persons
- Lack of support from mathematics associations
- Lack of infrastructural facilities
- Regular and rigid academic schedule
- Low organizational skills on the part of teachers
- Lack of leadership qualities in organizer

1.11. MATHEMATICS CLUB

A Mathematics Club is an organized group of individuals, having a some what homogeneous level of interest and ability in Mathematics who meet periodically to discuss mathematical topics.

--- Good C.V.

Every teacher of mathematics knows that the class room situation is not conducive to catering the needs of the gifted. This leaves a country impoverished through non exploitation of mathematical resources in students. So, professional integrity demands that mathematics teacher should join hands to set right the pathetic wastage of mathematical talent by providing a climate for fostering it in the school, which is possible only through a well organized and well run mathematics club.

In every class we find pupils who have an interest in mathematics and who are high achievers in the subject. The talent of such pupils should be properly nurtured in the class and also outside a regular class. For this purpose it would be useful to start Mathematics clubs in the schools.

There is another important reason for running a mathematics club. The creative period in person starts in a person's at his / her 14^{th} year and lasts till his / her 25^{th} year, as could be seen by the lives of most of the mathematicians and scientists. Unless pupils are exposed to widening frontiers of mathematical knowledge and its applications while they are in their teens, they would not be favorably disposed to mathematics when they grow up.

A Mathematics Club plays an important role in motivating the students to learn mathematics with interest and involvement. Some times mathematics teaching in class rooms becomes monotonous that the students become restless and get easily distracted. A Mathematics Club provides excellent opportunities for students to break away from monotony of a rigid and structured class room environment. Though the learning that takes place in Mathematics Club is informal in nature, it is meaningful as the stress is on the applications.

In Mathematics Club the student chooses the activities on his own and pursues them on his own interest in a free and relaxed manner contrary to the atmosphere prevailing in a classroom. Club provides a lot of freedom of expression for students and it supplements classroom teaching.

Annie John Williams, (1956) in her article entitled '*Organizing a Mathematics Club'* opined that mathematics clubs provide an excellent means of stimulating and fostering mathematical study. Membership in these clubs is usually voluntary, and for this reason the clubs are composed mainly of students who have a real interest in mathematics and who desire to obtain a view of the subject which is somewhat different from that gained in the classroom.

Such clubs offer excellent opportunities for free consideration of matters of special interest to the member without the necessity of having the programs follow any particular organic sequence of topics such as is generally necessary in regular class instruction.

Secondary school pupils, like all others, are dependent upon each other in their mental, physical, social, domestic, and other relationships. They listen to ideas expressed by others and add their own; they criticize and are criticized.

The fact that they don't always agree stimulates interest and motivates discussion. A mathematics club offers an ideal place for a free exchange of mathematical ideas and for frank and helpful criticism of these ideas. The club also makes possible informality and a social atmosphere, which the classroom can hardly provide.

The club should be an organization of, by, and for the students, the teacher being a sympathetic counselor whose main function is to foster a continuance of interest and to cooperate in guiding the activities of the club along appropriate lines. The principles of organization of a mathematics club should be neither numerous nor involved.

The objectives should be clearly stated and understood by all the members. Emphasis should be on active participation of the members. There should be inconspicuous but ready to advise and help when needed. In general, any criticisms that he might have to make concerning programs should be given in private to the individual students concerned.

It is desirable that each club limits its membership to such size that there will be opportunity for all to participate and that all meetings be held at regularly scheduled times.

1.12. PURPOSE OF THE MATHEMATICS CLUB

Like other subject clubs and societies, there is a genuine place for a Mathematics Club in a school of today. Broadly speaking, it will be organized in the same way or on the same pattern as other subject clubs or even co-curricular societies. The Mathematics Club is no longer a vague idea; it has become a reality in many progressive schools. This club can play a significant role in the total programme of a school.

--- Siddhu, K.S.

Dalton, L.C., and Synder, H.D. (1993), editors of the book, '*Topics for Mathematics club'* gives the main purpose of Mathematics club. One of the main purposes of a Mathematics Club is to provide the opportunity and climate for students to study and present, before their peers, exciting topics in mathematics that are not ordinarily discussed in the class room.

The purpose of starting a Mathematics Club can be stated as follows

- It can provide a forum to those interested in mathematical activities.
- The students get opportunity of mathematical hobbies, recreational Mathematics, mathematical projects, mathematical games, mathematical discussions and debates, and mathematical innovations.
- The club will be a medium of developing student's interest in the subject.
- It will provide to the students an opportunity of listening to experts and teachers from outside. They can be invited through this agency to-address the students on different topics.
- It initiates and develops mathematical expressions among the students.
- It can be an agency for providing intra-school and inter-school mathematical competitions.
- It can organize excursions and visits of mathematical value.
- It can provide an opportunity of extra reading of Mathematics and reading of general mathematical literature.

- It can be an agency to prepare and display mathematical illustrations.
- It can help in the decoration and equipment of the Mathematics room or laboratory.
- It will be a medium of exchange of mathematical information experience, experiments and innovations.
- It will provide to the student's opportunities of organizing various activities and thus develop their organizing ability.
- It will provide to some the opportunity of leadership and to many the opportunities of cooperation, joint responsibility and active participation.
- It can arrange mathematical filmstrip shows and film shows for its members.
- It can look after the Mathematics section of the school magazine.
- It can co-operate with other societies in the school for various functions.

1.13. NEED FOR THE STUDY

Educational systems around the world are under increasing pressure to use innovative methodologies and integrate various teaching and learning strategies to reach the 21st century learners. We realize two major shifts in the pedagogical thinking process

i) emphasis on student centered instructional strategies

ii) emphasis on higher level intellectual skills like Analysis, Synthesis and Evaluation.

In mathematics teaching, a teacher's effort in executing student centered instructional strategies can be seen through the conduct of co-curricular activities by him/her, which in turn influences the participation of students in learning the subject.

It was also implicitly accepted that a teacher's attitudes can influence his / her views on mathematics and its teaching. The teacher's main instructional task is to create activities that provide opportunities to the students to engage in higher order thinking.

The teacher can promote this ability among the students, if he is resourceful enough to create situations to participate in co-curricular activities which are strong enough to stir the students. This type of approach on the part of the teacher is not an isolated activity, but a mark of the characteristic teaching behavior, that can be observed on a continuum.

So making the teachers aware of co-curricular activities and trying to stimulate this faculty in them are two essential and useful things. Any attempt in this direction enables us to know the levels of organizing ability of the teachers in secondary schools. If a research work is taken up with the assumptions concerning the organization of co-curricular activities in mathematics; it will be highly beneficial to those who are in the field of education. Hence the study is taken up on secondary school teachers.

1.14. STATEMENT OF THE PROBLEM

Keeping the above discussion in view, the investigator proposed to take up this study, namely ***'A Study of the Organization of Mathematical Co-curricular Activities in Secondary Schools'***

1.15. OPERATIONAL DEFINITIONS

Co-curricular activities

Activities taken up by both teachers and students, supporting the teaching-learning process along with their regular classroom practices, not interrupting the academic results in a secondary school considered as co-curricular activities.

Secondary school

A school running academic classes for 6^{th} to 10^{th} class students is here after considered as a secondary school.

1.16. SIGNIFICANCE OF THE PROBLEM

Mathematics is not an easy subject. No worthwhile subject is easy, but it is a rewarding one. Mathematics is beautiful and intellectually stimulating. *G.H. Hardy,* the eminent mathematician who discovered the genius *Srnivasa Rmanujan,* has described the work of a mathematician as akin to that of an artist or poet.

The first step in popularization of mathematics is to stop cultural alienation of mathematics that we find today starting from school. The instructional methods adopted by teachers in schools and educators in colleges of education, writers of text books and programme designers in media continue to be unfavorable to mathematics viewed as a field of beautiful patterns and enchanting designs, breath taking structures and exciting hidden relations and connections, remarkable applications and model building ventures.

The present state of teaching mathematics in the majority of our schools is far from satisfactory. The rate of failures in mathematics is considerably higher than in other subjects. Many pupils find mathematics a difficult subject, whatever is the reason for this attitude.

Teachers need to capitalize on the natural curiosity and imagination, and devise experiences that help children to develop and sustain these characteristics, for affective assimilation of any subject. Many educators for learning and assimilating experience have usually acknowledged the importance of play in teaching children. If one were to study, the focus and style of school anniversary celebrations, one could see that mathematics shut out. Not only that, it is even justified that mathematics could never find a place in the celebrations as it is considered to be devoid of human sentiments and feelings, success and failures. It is not because of wide spreader ignorance about cultural aspects of mathematics and lack of exposure to struggle and adventures of great mathematicians. Their sufferings and struggles do match those of explorers, freedom fighters in ushering in newer and newer ideas and techniques, in broadening and refining the conceptual frame works already in vogue or in removing contradictions blocking progress in thinking.

So mathematics still not taught as an exploratory and experimental subject to help students learn mathematics with confidence and conviction. Full pledged support to independent learning of mathematical concepts by children requires setting up a mathematical laboratory as it done for science subjects.

In many countries, there is separate mathematics room fully equipped with audio visual aids, models, computers for graphics etc. requiring students to move into the room for their mathematics periods. This will be a dream come true in our educational planning and so a preliminary measure of setting up an activity centre.

Mathematics progress is in terms of conceptual clarity, grater abstraction and newer application, which mostly the university men of mathematics can alone expected to know. Do neither the schoolteachers, largely, get the urge or feel the pressure to know these tremendous developments in neither mathematical thought nor they given opportunities to expose to them.

A few interested teachers, how ever, maintain through private study and reflection their zeal for learning new things, teaching in new ways and transmitting new trends for the sheer joy of seeing children enjoy themselves through intellectual adventures. The influence of such teachers needs to allow spreading my means of a built in mechanism in the functioning of the schools and colleges.

There is stir and ferment in the atmosphere of learning mathematics in schools all over the world and it needs to channel in to constructive and creative endeavors so that mathematically gifted children could detect and taken care of early.

The above discussion reveals the importance of conducting co-curricular activities in mathematics, particularly in an organized manner. Further, it elevated some challenges.

- Do the secondary schools actively conduct co-curricular activities in mathematics?
- Do they have appropriate infrastructural facilities for organizing the activities?
- Do the secondary schools establish and organize mathematics clubs?

It observed that in many of our secondary educational institutions, there is a slit between organizing co-curricular activities and establishing mathematics clubs. Hence, the present investigation will have bearing on conducting co-curricular activities in mathematics and functioning of mathematics clubs.

1.17. OBJECTIVES OF THE STUDY

This investigation proposed to conduct with the following objectives

1. To study the level of organization of co-curricular activities in mathematics in secondary schools.
2. To study the popularity of different types of co-curricular activities those are conducted in mathematics at secondary school level.
3. To study the organization of mathematics clubs at secondary school level.
4. To find out the resources for the organization of co-curricular activities in mathematics at secondary school level.
5. To study the effect of demographic variables of teachers in conducting co-curricular activities in mathematics.

1.18. RESEARCH QUESTIONS

In order to carry out the investigation along the lines of these objectives for guidance of action, instead of research hypotheses, research questions framed, as the objective of the study is fact-finding.

I) Level organization of co-curricular activities

Are the Secondary schools organizing co-curricular activities in mathematics? If yes, at what level they are organizing?

II) Popularity of co-curricular activities

What are the different types of activities that are popular?

III) Existence and organization of mathematics club

Are the secondary schools organizing mathematics clubs?

IV) Resources for conducting co-curricular activities

A. What are the academic resources relating to conduct of co-curricular activities in mathematics?
B. What are the financial resources relating to conduct of co-curricular activities in mathematics?
C. What are the infrastructural facilities relating to conduct of co-curricular activities in mathematics?

V) Effect of demographic variables

A. Does the type of the school influence the conduct of co-curricular activities in mathematics?

B. Does the sex of the in charge of co-curricular activities influence the conduct of co-curricular activities in mathematics?

C. Does the teaching experience of the teacher influence the conduct of co-curricular activities in mathematics?

D. Does the experience as an in charge of the activities influence the conduct of co-curricular activities in mathematics?

1.19. LIMITATIONS

1. The study is limited to the geographical area of Krishna district in the state of Andhra Pradesh
2. The study is limited to the Secondary schools established up to the academic year 2006-2007 in Krishna district of Andhra Pradesh
3. Only one tool is administered to one school, since the nature of the tool is to observe the conduct of co-curricular activities in that particular school
4. Only descriptive statistics are taken up
5. Dimension wise analysis of the tool was not taken up

1.20. RESUME OF THE SUCCEEDING CHAPTERS

The investigator proposes to continue the succeeding chapters as follows.

Chapter–II deals with the review of related literature in four sections viz,

1. Studies on co-curricular activities in mathematics out side India
2. Co-curricular activities in mathematics suggested by mathematics educators with in India
3. Studies on co-curricular activities in mathematics with in India
4. Interviews with distinguished persons in the field of mathematics education

Chapter-III treats with type of research, construction of the tool, selection of the sample, administration of the tool, scoring procedure and statistical techniques adopted for the study.

Chapter-IV compacts with statistical description of the sample, and the statistical treatment done for the sample observations. Lastly

Chapter-V deals with summary of the study, findings, educational implications and suggestions for further research.

CHAPTER – 2
REVIEW OF RELATED LITERATURE

The literature in any field forms the foundation upon which all future work will be built. If we fail to build this foundation of knowledge provided by the review of the literature our work is likely to be shallow and will often duplicate work that has already been done better by someone else.

--- Borg

2.1. INTRODUCTION

In the present study, a review of related research has yielded very rich dividends. It was possible for the researcher to delimit and define the present problem on the basis of the researches undertaken earlier. Above all, the reviews gave very clear insight into the study area, enabling the researcher to define the objectives, the scope, measurement, and methodology. It was also possible to plan a new venture resulting in new relationships. Keeping in view what has already been accomplished in earlier researches, adequate care was taken to avoid duplication of established findings. Suitable extensions and modifications were made to prosecute new avenues of scope and procedure.

Study of related literature implies locating, reading and evaluating related research reports and articles and opinions of earlier authors that are related to the research work undertaken by the research worker. The review of related literature can help the research possibilities that have been overlooked. It will give the student the insight into and to convert his / her tentative research problem to a specific and concise one.

A familiarity with the literature of any problem area helps the students to discover what is already known, what others have attempted to? Find out what methods of attack have been promising or disappointing and what problems remain to be solved.

--- Best, J.W

The six volumes of *'Survey of Research in Education'* did not contain even a single study on the organization of co-curricular activities in mathematics at secondary school level. In the absence of related material on the topic, the investigator has taken resources to review literature available on some of the activities to be conducted by the mathematics clubs at secondary school level.

The investigator proposes to present the review of related literature in four sections.

5. Studies on co-curricular activities in mathematics outside India
6. Co-curricular activities in mathematics suggested by mathematics educators with in India
7. Studies on co-curricular activities in mathematics with in India
8. Interviews with distinguished persons in the field of mathematics education

2.2. STUDIES ON CO-CURRICULAR ACTIVITIES IN MATHEMATICS OUT SIDE INDIA

Farouq Almeqdadi (1991) studied on *The Effect of Using the Geometer's Sketchpad (G.S.P.) on Jordanian Students' Understanding Some Geometrical Concepts.* This study focused on using one of the computer's software, the Geometer's Sketchpad on students' achievement in mathematics. It gets its importance from the results of the 1994 study commission by the Software Publishers Association. Some of the conclusions of that study were the following

- Educational technology has a significant positive impact on achievement in all subject areas, across all levels of school, and in regular classrooms as well as those for special-needs students.
- Educational technology has positive effects on students' attitudes.
- Technology makes instruction more student-centered, encourages cooperative learning, and simulates increased teacher-student interaction.

Ali Deniz & et al. (1994) in their study on *'the effect of computers on teaching the limit concept'* concluded that

- Teaching the limit concept with using computer support has a positive effect in understanding the concept. The students perceive that the explanation on the computer as a real fact, whereas they perceive that the explanations in the classroom as an artificial feature.
- It is apparent that the (prepared) computer program has no meaningful contribution. Indeed the students attach more importance to operational process than the means of concepts and conceptual relations.

Lisa Wilson Carboni and Susan N. Friel (1996) studied on *'Using Instructional Videotapes in an Elementary Mathematics Methods Course.'* The findings were as follows

- The pre-service teachers viewed the videotapes as offering worthwhile learning experiences, suggesting that the use of videotapes can help instructors move students with different orientations in intended directions.
- The videotapes seemed to help these pre-service teachers develop a new picture of what a mathematics teacher is.

Ipek, A.Sabri & et. al. (2004) in their study on *'the Role of visualization approach on student's conceptual learning'* concluded that

- In visualization approach students can perceive relations between abstract concepts and semi-concrete structure and make sense of abstract concepts in mathematics, and thus this approach facilitates student's understanding abstract concepts.
- Including visualization into the teaching process increases the students' conceptual learning. It could be suggested that the teaching method applied in this study could be extended to teaching the other abstract concepts in mathematics.

Ismaṭ Ara and Rakhsi Saleem (2005) in their study oṇ *Role of Co-Curricular Activities: Survey of the Perceptions of Stake Holders (Case Study of Peshawar District)* found that

- Most of the schools have the facilities of co-curricular activities of one kind or the other and the schools also provide their students opportunities to participate in them.
- The study found that 30% schools have one period reserved for such activities and 10 % have two periods in a week.
- It was also found that only 60 % schools provide some portion of funds required for the arrangement of co-curricular activities whereas, in 40 % schools administration does not lend any financial support in arranging such activities.
- Most of the schools don't have specialized teacher specific to different set of activities.
- Substantial part of public and private schools does not hold appropriate infrastructure especially sports grounds. However, gravity of the deficiency in private sector is more than the public.

2.3. CO-CURRICULAR ACTIVITIES IN MATHEMATICS SUGGESTED BY MATHEMATICS EDUCATORS WITH IN INDIA

National Policy on Education, 1986 (N.P.E.) suggested some activities to be conducted at secondary school level. They are as follows.

- The pupils may be made to prepare mathematical models.
- They may be encouraged and helped to solve challenging types of problems
- They may be prepared to participate in mathematical competitions (Mathematical Olympiads)
- They may be taught additional mathematics to enrich their mathematical knowledge.

Alamelu, K. (1992) hassled the importance of having a separate room for conducting mathematical co curricular activities in her talk on '*Setting up mathematics laboratory'* at AMTI conference in Delhi as '*Full pledged support to independent learning of mathematical concepts by children requires setting up a mathemati9cal laboratory as is done for science subjects. In many countries, there is separate mathematics room fully equipped with audio visual aids, models, computers for graphics etc. requiring students to move into the room for their mathematics periods. This will be a dream come true in our educational planning and so a preliminary measure of setting up an activity centre'*.

Srinivasan, P.K. (1992) suggested ways and means of popularizing mathematics with *some measures of success through cultural rehabilitation of mathematics.* It is a twelve point programme for adoption by schools to start with

- Greeting the day of school cultural events after the prayer with a magic square
- Inclusion of magic square dance as a part of every cultural programme organized by the school
- Enacting the episodes from the historical break – through in mathematics and biographies and world class creative mathematicians
- Mock interviews with eminent mathematicians of the past represented by students wearing the facial masks of mathematicians
- Mathematical magic shows by groups of students with themes taken from topology and graph theory
- Number wizardry by gifted students in doing instant addition, multiplication etc.
- Students concocting and telling stories around facts of addition, multiplication, and division.
- Presentation of programmes for participation by audience such as Function game, Tower of Brahma, Sprees, Quiz etc.
- Talks on the power of mathematics in saving oneself from cheating in money spinning chains and lotteries, spreading of rumor etc.
- Brain storming sessions to expose Fallacies, Conundrums, Quibbles, Paradoxes, Howlers etc.
- Feature articles on mathematics by students in school annuals
- Greeting cards with mathematical motifs

Sastry, D.S.N. (2001) in his book **'Ganitamu-Sahapaathya Karyakramalu'**- a book on co-curricular activities in mathematics, illustrated some possible activities which can be practiced by teachers and students of mathematics in secondary schools as follows

- Mathematics exhibitions and fairs
- Mathematics quiz
- Mathematical dramas
- Ganita Asthavadhanamu
- Mathematical dance ballets
- Essay writing in mathematics
- Preparation of a scrap book in mathematics
- Ganita Antyakshari – A word game
- Writing poetry
- Recreational mathematics
- Riddles and puzzles
- Cross-word puzzles
- Mathematical word search

Surya Narayana, Duvvuri & et al (2005) suggested some possible activities as follows

- Popular lectures by distinguished mathematicians
- Popular lectures by other scientists and users of mathematics
- Popular lectures by students themselves
- Organization of quiz competitions, essay contests and debates
- Wall paper magazines
- Posters containing problems
- Organization of mathematical Olympiads
- Increasing mathematical literacy in the general public
- Organizing cultural activities based on mathematics
- Mathematical recreation clubs
- Organization of mathematics exhibitions

2.4. STUDIES ON CO-CURRICULAR ACTIVITIES IN MATHEMATICS WITH IN INDIA

Narasimharao, B.V.L. (1997) studied the *attitudes of school children towards mathematics fairs*. The sample for this study constituted secondary school participants at the District Mathematics Fair 1995-96 of Krishna and Guntur Districts of Andhra Pradesh. The tool designed for the study is a Likert type 3-point scale, which may be called Students Attitude to Mathematics Fairs Scale (S.A.M.F). The tool covers 4 broad areas, namely

- Attitude towards participation in Mathematics Fair
- Attitude towards Preparation of exhibits
- Attitude towards the themes of Mathematics Fair
- Attitude towards visitors and visitors' comments

Some of the objectives of the study were as follows

- To study the influence of mathematics fairs on the attitudes of the secondary school students towards mathematics subject
- To find the impact of themes on the attitudes of participants in mathematics fairs
- To find out the impact of exhibits on the attitudes of the participants in mathematics fairs
- To find out whether mathematics fairs can generate a favorable attitude in students towards mathematics learning

The hypotheses formulated for the study were as follows

- Students in general have a favorable attitude towards Mathematics Fairs
- Urban participants differ significantly from rural participants in their attitudes towards Mathematics Fairs
- Krishna and Guntur District participants differ significantly in their attitudes towards Mathematics Fairs
- There is significant difference in the attitudes of participants towards the identified areas also on account of sex, locality of living and district of domicile

The Major findings of the study were

- In Krishna district 61% of the participants expressed highly favorable attitude towards Mathematics Fairs and 28% expressed favorable attitudes. In Guntur District 75% expressed highly favorable attitude and 23% expressed favorable attitude towards Mathematics Fairs
- No significant difference is seen in the attitudes of boys and girls towards mathematics fairs
- Significant difference is seen in the attitudes of participants towards Mathematics Fairs between first participation and second participation.

Amulya Ratnamu, D (1998) made a comparative study of *Performance of Secondary School Children in Achievement Test and Cross Word Puzzle*. The sample constituted 180 students of VIII class comprising of urban and rural areas in Machilipatnam, Krishna district.

The sample consisted of 115 students from Machilipatnam rural area and 65 students from urban area including 70 boys and 110 girls. Tools used were Mathematical cross word puzzle and achievement test (objective type with completion type item) prepared on the same content *'Sets'*.

The objectives of the study were

- To find out if the students of VIII class perform equally on a mathematics achievement test and cross word puzzle based on the same test items on the same content
- To compare the performance of boys and girls on mathematics achievement tests and cross word puzzle
- To find out the relationship between schooling and performance on cross word puzzle and achievement test
- To find out if cross word puzzle can be used as an alternative to the traditional type of achievement test

The important findings of this investigation were

- VIII class students perform at different levels on cross word puzzle and achievement test in mathematics both constructed on identical content
- There is no significant difference in the performance of boys and girls on cross word puzzle constructed with same content as the achievement test
- There is significant difference between the performance of the students of the two schools on the crossword puzzle constructed with the same content and evaluation objectives as the achievement test
- Technically, the cross word puzzle can be used as an alternative to traditional type of achievement test, since

(a) The clues and solution of the crossword puzzle covered the same content area as the achievement test in terms of concepts and difficulty level.

(b) The crossword puzzle involved the same cognitive processes as in answering achievement test.

(c) Like the achievement test, the crossword puzzle also measured the performance of boys and girls and allows for grouping them according to achievement levels.

Shakila J. (2000) conducted a *study of participation of IX class students in co-curricular activities of Mathematics in Guntur city.* The investigator had taken up a stratified random sample of 40 schools and 200 students from IX class in and around Guntur city.

The sample consists of students from Zilla parishad high schools (Rural), Municipal schools (Urban), Private schools (Rural and Urban), Telugu and English Medium schools (Rural and Urban). Tool of the present study is a questionnaire consisting of 30 questions with 3 alternatives. Some of the objectives of the study were

- To identify various opportunities to students in co-curricular activities of mathematics
- To find out the level of participation of students in co-curricula! activities of mathematics

- To find out whether there is any difference in the opportunity in co-curricular activities of mathematics between
  a) Rural and urban students
  b) English and Telugu medium students
  c) Government and Private Students
- To find out whether there is any difference in the participation in co-curricular activities of mathematics between
  a) Rural and urban students
  b) English and Telugu medium students
  c) Government and Private Students
  d) Boys and Girls
- To find out the relationship between the opportunity and participation in co-curricular activities of mathematics.

The Major Findings of the study were

- Opportunities for mathematical activities are found to be more. It means IX class students sampling experience more opportunities in mathematical activities. Schools are found to be heterogeneous in providing the opportunity in mathematical activities
- The students' participation in co-curricular activities of mathematics is found to be moderate extent. Heterogeneous participation of students is found in mathematical activities
  a) 50% of students participated in discussions, number puzzles, mathematical games, visiting mathematics fairs, making models be moderately participated
  b) 50% of students didn't participate in essay writing, debates, mathematics exhibition and preparing improvised apparatus be rarely participated
- The opportunities in mathematical activities of both Government and Private schools are more.
  a) There is a significant difference between the Government and private schools in opportunities of mathematical activities
  b) The mean is in favor of Private schools

- The students' participation in mathematical activities of both rural and urban area schools are to a moderate extent.
  a) There is no significant difference between the rural and urban schools in the participation of mathematical activities.
  b) Students are found to be participating in mathematical activities to moderate extent of both English and Telugu medium schools.
  c) There is a significant difference between the English and Telugu medium schools in the participation of mathematical activities.
  d) The mean is in favor of English medium schools.

- a) Students found to be participating in mathematical activities of both private and government schools to a moderate extent.
  b) There is no significant difference between the participation of mathematical activities in government and private schools

- a) Boys and Girls are found to be participating in mathematical activities to moderate extent
  b) There is no significant difference between Boys and Girls in participating in mathematical activities

- a) There is a significant relationship between opportunities and students participation in mathematical activities.
  b) There is a significant difference in the participation of students in English and Telugu medium schools and Boys and Girls.
  c) There is no significant difference in the participation of students in co-curricular activities in rural and urban, government and the private schools.

Natesan, N. (2001) in his study on *'Teaching Concepts in Mathematics through Video Cassette – An Experiment'* found that the increment in the level of academic achievement of experimental group was due to the teaching of mathematical concept through video-cassette. He further observed that there was a significant difference between boys and girls in all groups. In all, the girls' performance was superior to boys.

Athipenr; C.P. (2002) in his study on *Impact of using simple techniques in mental arithmetic* found that

- Using simple techniques in mental arithmetic has increased the speed and accuracy of class VI pupils.
- There is no significant difference either among boys and girls or among rural and urban pupils in the speed and accuracy in doing mental arithmetic.

Bhatnagar, M.A. (2002) in his study on *Co-curricular Activities based Programme in Selected Institutions of Lucknow* found that

- Co-curricular activities release stress & anxiety among students
- Co-curricular activities based programme provides opportunities to teachers to develop their teaching competence
- The programme broadens the scope of using all the Gardner's seven intelligence dimensions to become more competent in social and academic fields
- The most of the students who do not participate in any of the activities are low achievers but getting appreciation for their little efforts, they perform better in academics because of the developing self - esteem.
- It was found the teacher became a facilitator and made the classroom more active, lively and creative

Sarala, Duvvuri (2002) in her study on the *functioning of mathematics clubs in colleges of education in Andhra Pradesh* found that

- Sixty seven percent of the colleges of education have mathematics clubs
- Sixty nine percent of the club conveners have more than 5 years of teaching experience and the remaining 31% of them have less than 5 years of experience.
- Sixty three percent of the sample colleges of education subscribed the journal **'**Ganita Chandrika**'**.
- Celebration of birth days and death days of mathematicians and conducting mathematics quiz to the teacher trainees were the most popular activities organized by the mathematics clubs. The percentage of these activities was 92.
- Arranging lectures by eminent persons and helping in the development of mathematics laboratory were the next popular activities (86%)

- Sixty nine percent of the mathematics clubs were maintaining bulletin boards, as reported by them
- The items that got lowest percentage (23%) were administering word search, preparing script magazine, and arranging 'Ganita Astavadhaanam'
- Sixty nine percent of the mathematics clubs were organizing the activity participation of the club members in the competitions as judges or evaluators. This activity got highest percentage in the category of external activities organized by the mathematics clubs outside the college campus
- Participating in the mathematics quiz organized by other colleges of education was organized by 63% of the clubs as the second highest activity under the external activities category.
- The activity, which got third place in the external category, was the participating in mathematics fairs organized by other authorities with 52%
- The least one with percentage of 17 was the external activity – preparing high school students for different mathematical talent tests.
- Eighty seven percent of the mathematics clubs in colleges of education were self financing i.e. The teacher-trainees subscribing for the club
- With regard to the academic support to the mathematics club, 64% of the clubs were received from faculty members other than the club convener
- Only 12% of the mathematics clubs in colleges of education received financial support from local schools and 6% of the clubs received support from any sponsoring agency

Venkata Murali Krishna, L (2004) in his '*Comparative study of performance of IX class students on achievement test and a cross word puzzle in Matrices'* concluded that

- Ninth class students perform at different levels on cross word puzzles and achievement test in mathematics, both constructed on identical content.
- There was no significant difference between the performance of government and private school students on the mathematical achievement test.
- There was no significant difference between the performance of government and private school students on cross word puzzles.
- The crossword puzzles can be use as an alternative to traditional type of achievement tests.

Surya Narayana Murthy, T.S.V.S., (2005) concluded in his '*Performance of VIII class students in mathematics on an achievement test and a crossword puzzle-a comparative study'* that

- There was no significant difference in the performance levels of VIII class students on cross word puzzle and achievement test in mathematics.
- There was no significant difference in the mean scores of local body and government school students on a crossword puzzle.

Gayathri, S (2006) in her study on '*Multimedia Usage by Mathematics Teachers'* concluded that the mathematics teachers in schools affiliated to C.B.S.E. in Bangalore city showed a remarkable evidence of highly favorable attitude towards multimedia usage.

2.5. INTERVIEWS WITH DISTINGUISHED PERSONS IN THE FIELD OF MATHEMATICS EDUCATION

Sarma, P.S.N. (2008) expert in conducting co-curricular activities in mathematics and mathematics modeling suggested the following activities

- Conducting orientation classes to local school teachers
- Maintaining a mathematics club
- Establishing mathematics museums
- Training classes on Vedic Mathematics
- Undertaking mathematics project works
- Conducting mathematics at different levels
- Lectures by eminent persons on mathematics history / utility etc
- Special classes to students by resource persons
- Undertaking mathematics modeling
- Preparing students for talent tests etc
- Conducting mathematics fairs
- Publishing a script magazine
- Collecting information from mathematics journals

Murthy T.S.V.S. Surya Narayana (2008) suggested the following activities that are to be conduct at secondary school level

- Arranging ‘Ganita Asthavadhanam’
- Preparation of scrap books
- Demonstration of speed mathematics techniques
- Exposing students to Radio and T.V. programmes
- Conducting cultural and literary activities like Dramas Play lets, Skits, Songs, Dances etc
- Special emphasis on Indian mathematics

It is to observe from the above discussion that so far no attempt has made by educational researchers to study the organization of co-curricular activities in mathematics at secondary school level. Hence, the investigator in his humble way tries to take up this aspect for research.

CHAPTER – 3
RESEARCH PROCEDURE

Research is systematic and refined technique of thinking, employing specialized tools, instruments, and procedures in order to obtain a more adequate solution of a problem than would be possible under ordinary means. It starts with a problem, collects data or facts, analyses them critically, and reaches decisions based on the actual evidence.

--- Crawford, C.C.

3.1. INTRODUCTION

The secret of cultural development has been research, pushing back the areas of ignorance by discovering new truths, which in turn lead to better ways of doing things and better products.

---Best, J .W.

Research is an endless quest for knowledge or unending search for truth. The knowledge obtained by research is scientific and objective and is a matter of rational understanding, common verification, and experience. It is a deliberate effort to collect information, to shift it, to analyze it, to put it together and to evaluate it. It works with a high degree of organization on a rather well defined problem and pursues it hopefully to a successful conclusion. It is a careful search for solutions to the problems that plague and puzzle the humankind.

Educational research is that activity which is directed towards development of a science of behavior in educational institutions. The ultimate aim of such a science is to provide knowledge that will permit the educator to achieve his goals by the most effective methods.

--Travers.

3.2. TYPE OF RESEARCH

The present investigator intends to study the organization of co-curricular activities in mathematics at secondary school level. The objective of the study is to gather data pertaining to the activities organized by secondary schools and the existence / functioning of mathematics clubs. Thus the present study comes under ***Descriptive Research.*** It is one of the main types of fundamental research. The other types are historical research and experimental research. Historical research is the application of scientific method to the description and analysis of past events. Experimental research describes what will be when all relevant conditions are carefully controlled. The basic assumption of the method rests upon the law of single variable.

Descriptive study describes and interprets what is. It is concerned with conditions or relationships that exist, opinions that are held, processes that are going on, effects that are evident, or trends that are developing. It is primarily concerned with the present, although it often considers past events and influences as they relate to current conditions.

--- Best and Kahn

Descriptive research is also called as **'Survey'**. It involves a clearly defined problem and definite objectives and requires expert and imaginative planning, careful analysis, interpretation of data gathered and logical and skilful reporting of the findings.

Mouley (1964) stated that the survey is more realistic than the experimental in that it investigates phenomena in their natural setting. The survey method gathers data from a relatively large number of cases at a particular time. The present study falls under descriptive or normative survey. To carry out any of the types of research investigation, data is gathered by a variety of research tools. Each tool is particularly appropriate for certain sources of data, yielding information of the kind, and in the form that would be most effectively used.

The intention of the present study is to collect data regarding the activities conducted and organized by mathematics clubs at secondary schools. Further, the investigator wants to know the different types of co-curricular activities conducted by a school or by the mathematics club organized by it. The investigator is under the impression that checklist is the appropriate tool. The checklist, the simplest of the devices, was prepared with list of behaviors or items. Checking yes or no may indicate the presence or absence of the behavior or inserting the appropriate word or number may indicate the type or number of items. Checklists also can be used to count the number of behaviors occurring in a given time period.

3.3. CONSTRUCTION OF THE TOOL

In order to prepare the tool for the present study, the investigator thoroughly studied various textbooks on co-curricular activities in mathematics. The list of activities to be organized in a secondary school or by a mathematics club in a secondary school, suggested by many authors of 'Methods of teaching mathematics' and other textbooks writers was collected and presented here under.

Butter and Wren (1960) suggest the following activities

- The programs of mathematics clubs may cover a wide range of topics, many of which have been listed are discussed in numerous books and in articles in such periodicals as the Mathematics Teacher, School Science and Mathematics, the Pentagon and the Mathematics Student Journal
- These will include topics drawn from the history of mathematics, including biographical sketches and interesting anecdotes; the evolution and development of certain aspects of present-day mathematics; topics from algebra; geometry, arithmetic or trigonometry; games and contests; and applications to other subjects and fields of activity
- Discussion of some elementary aspects of modern mathematics may well rate some priority in club programs
- The nature of the programs and topics to be discussed depend considerably upon the age and advancement of the members of the club

Mangal, S.K. (1981) lists out the following activities to taken by a mathematics club

- Holding of the mutual discussion over the important topics of mathematics (with in and outside the syllabus)
- Organizing lectures of the distinguished scholars and teachers on useful topics.
- Publishing of newsletter and bulletin of the club
- Organizing of inter-class or inter-school declamation contents debates and symposia on some interesting mathematical topics
- Organizing mathematical exhibition or fairs
- Helping in the establishment of mathematics laboratory (the making of charts, models, improvised apparatus and collection of useful material)
- Helping in the maintenance and organization of mathematics library and laboratory
- Making arrangement for listening the radio transmission on the topics of mathematics interest
- Making arrangement for taking advantages of television talk and lessons concerning mathematics
- Celebrating days, events of the history and men of the mathematics
- Organizing useful competition like mathematics games, riddles, puzzles and catch-problems, quiz competitions
- Organizing relevant seminars and career courses
- Organizing visits and excursions of the places of mathematical interest
- Conducting useful individual or group projects
- Arrangement of wall magazine
- Arranging help and guidance for the backward children in mathematics

Siddhu, K.S. (1981) listed out the following activities those can take up by a mathematics club

- Mathematical games, hobbies, projects, experiments, data collection, discussions and debates and innovations
- Lessons and lectures by prominent teachers from outside
- Lectures by experts of allied subjects and professions
- Organizing mathematical competitions

- Organizing excursions and visits of mathematical value
- Preparing mathematical aids and illustrations
- Decorating and equipping mathematics room and laboratory
- Organizing general and extra reading in mathematics
- Arranging mathematical shows, exhibitions etc
- Mathematical articles for the school magazine
- Looking after the interests of the subject
- Collaboration with other clubs and societies in the school functions

The National Policy on Education (1986) suggests variety of activities those can be organize in the mathematics club

- The pupils may be made to prepare mathematical models
- They may be encouraged and helped to solve challenging types of problems
- They may be prepared to participate in mathematical competitions (mathematical Olympiads), which are being conducted by mathematics teachers associations
- They may be taught additional mathematics to enrich their mathematical knowledge and so on

Gill, Sharma and Sudhir Kumar (1989) listed out the following activities to be taken up by a mathematics club

- Organizing inter- class, inter-school competitions on some interesting mathematical topics
- Arranging a lecture by some renowned mathematics teacher or scholar
- Celebrating days and events pertaining to the history of mathematics or men of mathematics
- Organizing discussions about the practical applications of mathematics
- Organizing recreational activities in mathematics such as puzzles, riddles, catch-problems, number games etc.
- Making or collecting charts, models, pictures, graphs etc., for the mathematics laboratory
- Conducting related project activities

- Preparing items for wall magazine
- Organizing mathematical exhibitions or fairs
- Organizing certain outings of mathematical interest such as visits to post-offices, banks, market places, big business concerns etc
- Organizing paper - reading contests about certain important topics of mathematics
- Making arrangements to listen to certain radio broadcasts on mathematical topics.
- Organizing seminars and career courses relating to mathematics

The following is the list of activities suggested for a mathematics club given in the reading material to B. Ed. Degree (Correspondence course) of *Madurai Kamarai University* (1997), Madurai.

- Members can read papers on topics of mathematical interest
- They can read important events in the biographies of famous mathematicians, talk about the historical development of certain mathematical concepts such as pi etc.
- Paper cutting and paper folding can discover mathematical truths
- Quiz programmes can be conducted
- Mathematical models aids and instruments can be made
- New and easier methods of solving certain mathematical problems can be found
- Applications of Mathematics to other subjects and fields of activity can be studied
- Collections can be made for mathematical museum
- Recreational aspect of mathematics may be discussed

In pursuance of the preparation of the tool, the investigator had a series of discussions and interviews with the lecturers teaching methods of teaching mathematics in colleges of education and expert teachers in the field of conducting co-curricular activities in mathematics at secondary schools. The teaching experience of these faculty members and experts ranged from 10 to 35 years. Because of these fruitful discussions and the study of available literature, the investigator was in a position to prepare the tool. The investigator prepared a list covering all the activities suggested by the different authors.

The list covers activities to organize in a secondary school or by a mathematics club in a secondary school. Since the present investigation is intended to study the organization of co-curricular activities in secondary schools, the investigator submitted the same to the experts in conducting co-curricular activities in mathematics and requested them to offer their suggestions, keeping in view the activities organized in secondary schools and by the teacher education institutions through mathematics clubs. The experts accepted all the items in the list submitted by the investigator.

Hence, the investigator finalized the tool for his investigation. The tool is in the form of a checklist. The respondents have to give check-mark responses to the items given in the list. The activities taken up by the secondary schools or by the mathematics clubs in corresponding schools categorized into two parts. The first part consists of activities taken up by the teachers, students and by both of them. The second part consists of the available infrastructural facilities exist in a school to conduct co-curricular activities in mathematics. The finalized list of activities is mentioned here under.

ACTIVITIES TAKEN BY THE TEACHERS

1. Preparation of Teaching-Learning material by Teachers (T.L.M.)
2. Display / Demonstration of the models in the school
3. Mathematics project works undertaken
4. Participation in mathematics fairs outside the school
5. Using computers for teaching learning material in mathematics
6. Conduct of mathematics quiz to the class students only
7. Conduct of mathematics quiz on special occasions
8. Conduct of mathematics quiz for local schools
9. Administering mathematics cross word puzzles
10. Administering mathematics word search
11. Arranging ‘Ganitha Asthavadhanams’
12. Demonstration of speed mathematics techniques by staff
13. Lectures by eminent persons on mathematics history / culture / utility

14. Special classes for students by resource persons on mathematics related things
15. Conduct of Workshops / orientation classes for the faculty members
16. Conduct of Workshops / orientation classes for local students
17. Exposing students to Radio lessons in mathematics
18. Radio Lessons with students on mathematics
19. Exposing students to Tele school programmes in mathematics
20. Exposing students to Mana T.V. programmes in mathematics
21. Collection of material for mathematics talent tests & Olympiads
22. Encouraging students to write mathematics articles to School magazine
23. Encouraging students to write mathematics articles to other magazines
24. Collection of reference material from Journals subscribed by the School
25. Conducting mathematics exhibition as a part in school science exhibition
26. Conducting separate mathematics exhibition in the school

ACTIVITIES TAKEN BY STUDENTS

27. Preparation of Teaching -Learning Material by students (T.L.M.)
28. Participation in mathematics fairs outside the school
29. Maintaining a bulletin board
30. Participation in mathematics quiz conducted by other agencies
31. Mathematics project works undertaken
32. Demonstration of speed mathematics techniques by students
33. Collection of material for mathematics talent tests & Olympiads
34. Collection of mathematics related news paper cuttings
35. Preparation of scrap books
36. Display of paper cuttings and photos on charts
37. Preparation of Script magazine in mathematics
38. Maintenance of wall magazine in mathematics
39. Contributing Mathematics related books to the school
40. Writing mathematics related things or completing puzzles in papers / magazines
41. Collection of reference material from Journals subscribed by the School

ACTIVITIES TAKEN BY BOTH TEACHERS AND STUDENTS

42. Participation in mathematics fairs outside the school
43. Celebration of Birth days / death anniversaries of mathematicians
44. Celebrating important occasions in mathematics
45. Special emphasis on Indian mathematics at School level
46. Cultural programmes relating to mathematics in the form of Play lets / Songs/ Dance etc
47. Open-ended question (Please specify any other…)

ENCOURAGEMENT TO ACTIVITIES

FINANCIAL SUPPORT

48. Support from management
49. Funds from special fee
50. Contribution from staff members
51. Contribution from students voluntary
52. Contribution from old students / parents
53. From any sponsoring agency / donors
54. Support from local mathematics associations
55. Support from local schools
56. Collection of separate fee from students

ACADEMIC SUPPORT

57. Staff members
58. Local mathematics associations
59. Local schools
60. Resource persons

INFRASTRUCTURAL FACILITIES FOR THE ORGANIZATION OF CO-CURRICULAR ACTIVITIES

61. Separate room
62. Stationary
63. Power supply
64. Computers
65. Internet
66. Preservation facilities for the models in the school

Basing on the similarity in nature of the activities and association with other activities, the ***items*** in the finalized tool classified in to six different dimensions. They are as under.

Dimension –I

Preparation and Demonstration of Teaching –Learning Material (T.L.M.)

Teaching-Learning Material is a physical visible device or substance, with which the teacher can envisage the concept and can easily introduce and explain the lesson that he / she is going to teach in the class. These can be prepared by using different materials like Paper, Wood, Colors, Photographs, Cardboard, Waste material etc. Writing the statements of the theorems, quotations by different mathematicians on charts, preparing different mathematical models by using cord board and related material are some of the examples of teaching-learning materials.

The next step after preparation of the material is to demonstrate in the class according to the situation while the lesson is going on, and after that placing it permanently in a separate space provided for it basing on the preservation facilities available.

Dimension –II

Mathematics fairs

Of all the activities and programmes, holding a mathematics fair or exhibition, which can better characterized as an exposition of patterns and powers of mathematical thinking, tops the list. It is at once the most glamorous and popular activity, bringing together the teacher and the pupil in a very purposeful partnership and also the school and the community in a very useful association. Mathematics fair means, any pre-planned programme arranged to allow secondary students to present their understanding of mathematical benefits through the exhibits prepared by them. In other words, it is the display or exhibiting the teaching-learning materials and other related material prepared by both teachers and students on special occasions.

Dimension –III

Mathematics Quiz

Quiz is a well-known co-curricular activity. Creating passion towards the subject matter of mathematics is the main motto of conducting a quiz. Asking thought provoking questions in different ways is the main activity of the quiz. The object of the quiz programme is to encourage acquisition and command of mathematical facts, rather than skills.

Dimension –IV

Enrichment programmes

The type of activities that are prepared, keeping in view the gifted students in the classroom can be termed as Enrichment programmes. These activities give special attention to the gifted students. Apart from the regular curriculum, these activities cover more content in mathematics and give a chance to the gifted students to improve special abilities in mathematics.

Dimension –V

Exposure to Media

Using multimedia approach in teaching learning process can be termed as exposure to media. Using Television and Radio in order to give more comprehension on a particular topic to the pupil comes under this category. Providing an opportunity to the pupil to listen the educational programmes broadcasted by different media and at the same time encouraging them to participate in those programmes could be done by the teacher of mathematics. Also preparing similar model lessons by the teacher individually or along with his / her students for these purposes and giving such programmes in different media may done in this direction.

Dimension –VI

Mathematics-Literary and Cultural activities

Mathematics as an art form lends itself to dramatization, field events, storytelling, blending of patterns and designs with music etc with tremendous appeal to aesthetic sense in man. In general, we find songs, play-lets, skits, etc as cultural events in various occasions. In case of language subjects also, we could have seen such type of activities, promoting interest and curiosity towards the subject matter. The same case may be applied to the subject of mathematics. Preparing the students to write poems, songs, game shows etc in mathematical terminology comes under the concept of literary and cultural activities in mathematics. An innovative and uncommon activity in this sector is performing **'**Ganitha Asthavadhanam**'**. It is similar to the well-known literary form **'**Astavadhanam**'** in Telugu language. Applying this thought to the field of mathematics ***Prof. Sastry, D.S.N.,*** scholar in the field of mathematics education, especially in conducting co-curricular activities in mathematics made a great effort to stretch this concept of **'**Ganita Asthavadhanam**'** by giving training to about 20 students through his 'Aryabhatta Mathematics Club**'**, A.J. College of education, Machilipatnam, Krishna district, Andhra Pradesh.

The dimension wise classification of ***items*** in the finalized tool is presented in Table 1.

TABLE 1

Classification of items- Dimension wise

S. No	Name of the Dimension	Activities taken up by		
		Teachers (Item No)	**Students (Item No)**	**Both (Item No)**
1.	I	1, 2, 5	27, 29, 34, 35, 36, 38	42
2.	II	4, 25, 26	28	-
3.	III	6, 7, 8	30	-
4.	IV	3, 12 to15, 16, 21	31, 32, 33, 39	-
5.	V	17, 18, 19, 20	-	-
6.	VI	10, 11, 22 to24	37, 40, 41	43 to 46

3.4. SELECTION OF THE SAMPLE POPULATION

In any statistical investigation, the interest usually lies in studying the various characteristics relating to items or individuals belonging to a particular group. The group of individuals under the study called the population or universe. By population in a research project means the aggregate or totality of objects, subjects or individuals regarding whom the inferences are to be done. Under this study, the investigator considered the entire secondary schools in the district of Krishna as sample for the study. As per the data of the District Educational Officer, Machilipatnam there were 676 secondary schools in the year 2007. These 676 schools form the entire population.

SAMPLE

A finite sub-set of population selected from it with the objective of investigating its properties called 'Sample'. The number of units in the sample called the sample size. A sample is a small proportion of a sample selected for observation and analysis. By observing and analyzing the sample, a research worker makes inferences about the characteristics of a population from which it is drawn.

3.5. ADMINISTRATION OF THE TOOL

As it is difficult to study the entire population, the investigator selected a sample out of the total population. As per the statistical data taken from the District Educational Officer, Krishna district–the district Krishna was divided in to five educational divisions and each one is headed by a Deputy Educational Officer (Dy.E.O). These are Machilipatnam, Vijayawada, Nandigama, Nuzivid and Gudivada. In each of these divisions there are 145, 173, 102, 132 and 124 secondary schools are running at present respectively.

By random sampling method the investigator selected 70 schools from Machilipatnam division, 85 from Vijayawada division, 53 from Nandigama division, 60 from Nuzivid division and 65 schools from Gudivada division. Hence, a total of 333 schools were selected for observation. Out of these schools, the investigator distributed the tool to 102 schools personally and to 231 schools by post.

Within a week he received 63 filled tools in return by post in total. After giving continuous reminders to the rest of the schools, only 26 filled tools came back. The investigator continued the same procedure to get back the tools. At last 29 filled tools came in return. The remaining was not yet received. With this the investigator got a total of 118 filled tools in final. Out of these, after verification 7 tools were found not properly filled. Hence they were removed from list. At last, only 111 schools constituted the final sample.

Necessary instructions for filling the tool given orally to those sample teachers who given the tool personally by the investigator himself. And for the other sample members the investigator posted the tool in a sealed cover along with self addressed and stamped envelop. Also, a covering letter was attached to the tool containing the particulars- the name of the investigator; the purpose of the study; the incentive- why should the respondent bother to answer; the directions for filling it out; the guarantee of secrecy.

To get back information relating to items in the tool, the respondents were requested to furnish the same. The pertaining items are printed in Page No. 2 and 3 of the tool. The respondents were requested to put a tick mark **'✓'** against a particular activity if the activity was taken up by them and to put a **'X'** mark otherwise.

3.6. SCORING PROCEDURE

After receipt of the filled in check list, scoring procedure was adopted by the investigator. The investigator noted the **'✓'** mark responses as that activity was taken up by the particular teacher / school and **'X'** mark responses were treated as that activity not taken up by them. The data obtained from such scoring of the filled in tools was tabulated.

3.7. RELIABILITY AND VALIDITY

The tool used for the present study is a checklist. This was prepared after having thorough study on co-curricular activities in mathematics and various co-curricular activities suggested by various authors. Hence, the tool has content validity. Moreover, the tool was prepared after having thorough discussions with distinguished persons in the field of mathematics education and proficient in conducting co-curricular activities in mathematics at secondary school level. Hence, by nature itself the tool has expert validity. As a whole, the tool has both content and expert validity. Moreover, the tool used is checklist and the objective of the present study is fact-finding, no attempt made to establish reliability and other types of validity.

3.8. STATISTICAL TECHNIQUES ADOPTED

The following statistical techniques were adopted where ever appropriate.

- The total number of activities in terms of frequency taken up by an institution
- Percentage
- Rank

CHAPTER – 4
ANALYSIS OF DATA AND INTERPRETATION OF RESULTS

Bare facts, objective data, never determine anything. They become significant only as interpreted in the light of accepted standards and assumptions, and these standards in the final analysis are not susceptible of scientific determination. In ordinary life, we seldom deal with bare facts but facts interpreted. This interpretation or evaluation determined by the purpose to which we relate the facts.

---Martz

4.1. INTRODUCTION

The next step in the process of research is the organization, analysis and interpretation of data and drawing conclusions and generalizations to obtain a meaningful picture out of the raw information collected. The analysis and interpretation of data involve the objective material in the possession of the investigator and his subjective reactions and desires to be derived from the data. The mass of data collected needs to be systematized and organized i.e., edited, classified and tabulated before it can serve the purpose.

The analysis and interpretation of data represent the application of deductive and inductive logic to the research process. Interpretation calls for critical examination of the results of one's analysis in the light of all the limitations of his data gathering and his subjects' attitude. To avoid subjectivity one must be critical of one's own thinking.

The objective of this investigation is to find out the organization of co-curricular activities in mathematics at secondary school level. To find out the existence and functioning of the mathematics clubs at secondary school level is another objective of this study. These objectives were translated into five research questions, which will be verified in course of this chapter.

4.2. STATISTICAL DESCRIPTION OF THE SAMPLE

In order to realize the objectives stated, a checklist was administered. The sample for the study constituted 111 secondary schools scattered throughout Krishna district of Andhra Pradesh. The variable wise (type of school) description of the sample is presented in Table 2.

TABLE 2

Type of School – Total, Percentage

S.No	Variable	Number of Schools	Percentage
1.	Government *	67	60.36
2.	Private aided	11	09.91
3.	Private Unaided	33	29.73
	Total	**111**	**100**

***** Municipal schools are also included in this category

From Table 2, it is observed that the sample comprises 111 secondary schools in Krishna district of Andhra Pradesh. Out of these, 67 schools are Government schools. Eleven are private aided schools. The remaining 33 are managed by private organizations.

4.3. STATISTICAL TREATMENT OF THE DATA

The objective of the study is fact finding, related to the organization of mathematical co-curricular activities in secondary schools. For this five research questions were formulated. The statements in the check list were categorized under the five research questions. The ***total*** responses and ***percentages*** for each statement were calculated. The statistical measure ***rank*** was also calculated where ever applicable. The information is presented in research question wise form Table 3 to Table 19.

RESEARCH QUESTION-1

Level organization of co-curricular activities

Are the Secondary schools organizing co-curricular activities in mathematics? If yes, at what level?

Activities taken up by the teachers

Out of the 67 statements given in the check list, 47 are representing the activities taken up by the teachers (S.No. 1 to 26 in the check list), students (S.No. 27 to 41 in the check list), and both (S.No. 42 to 47 in the check list). For the twenty six activities taken up by the teachers - the total responses, percentage and rank were calculated. The information is presented in Table 3.

TABLE 3

Activities taken up by the teachers –Total, Percentage, Rank

S.No	Activity	Total	%	Rank
1.	Preparation of T.L.M by Teachers	105	95	1
2.	Display / demonstration of the models in the school	92	83	2.5
3.	Undertaking mathematics Project works	28	25.2	16.5
4.	Participation in mathematics fairs outside the school	49	44.14	6
5.	Using computers for T.L.M. in mathematics	15	13.5	24
6.	Conduct of mathematics quiz to the class students only	92	82.88	2.5
7.	Conduct of mathematics quiz on special occasions	71	63.96	4
8.	Conduct of mathematics quiz for local schools	32	28.83	14
9.	Administering mathematics cross word puzzles	38	34.2	10
10	Administering mathematics word search	31	27.9	15

11.	Arranging 'Ganita Asthavadhanam'	05	4.5	26
12.	Demonstration of speed mathematics techniques by staff	36	32.4	11.5
13.	Lectures by eminent persons on mathematics history / culture / utility	25	22.52	18.5
14.	Special classes for students by resource persons on Mathematics related things	35	30	13
15.	Conduct of Workshops / orientation classes for the faculty members	21	18.9	20
16.	Conduct of Workshops / orientation classes for local students	13	11.7	25
17.	Exposing students to Radio lessons in mathematics	36	32.4	11.5
18.	Radio Lessons with students on mathematics	28	25.2	16.5
19.	Exposing students to Tele school programme in mathematics	41	36.93	8
20.	Exposing students to Mana T.V. programme in mathematics	39	35.13	9
21.	Collection of material for mathematics talent tests & Olympiads	42	37.84	7
22.	Encouraging students to write mathematics articles to School magazine	19	17.1	22
23.	Encouraging students to write mathematics articles to other magazines	25	22.52	18.5
24.	Collection of reference material from Journals subscribed by the School	20	18.02	21
25.	Conducting mathematics exhibition as a part in school science exhibition	59	53.2	5
26.	Conducting separate mathematics exhibition in the school	16	14.4	23

From Table 3, it is observed that the frequency of the activities taken up by the teachers ranges from 4.5% to 95%. The activity 'preparation of T.L.M by teachers' stood in first and the activity 'arranging Ganita Asthavadhanam' stood in last. No activity in the list was left with any practice. From this information, it can be inferred that the teachers at secondary school level are organizing co-curricular activities in mathematics.

Activities taken up by the Students

Out of the 67 statements given in the check list, 47 are representing the activities taken up by the teachers (S.No. 1 to 26 in the check list), students (S.No. 27 to 41 in the check list), and both (S.No. 42 to 47 in the check list). For the fifteen activities taken up by the students - the total responses, percentage and rank were calculated. The information is presented in Table 4.

TABLE 4

Activities taken up by the Students–Total, Percentage, Rank

S. No	Activity	Total	%	Rank
1.	Preparation of T.L.M. by Students	89	80	1
2.	Participation in mathematics fairs outside the school	54	49	5
3.	Maintaining a bulletin board	32	28.8	9
4.	Participation in mathematics quiz conducted by other agencies	40	36.04	7
5.	Undertaking mathematics Project works	22	19.8	12
6.	Demonstration of speed mathematics techniques by students	38	34.23	8
7.	Collection of material for mathematics talent tests and Olympiads	43	38.74	6
8.	Collection of mathematics related news paper cuttings	80	72.07	2
9.	Preparation of scrap books	57	51.4	4

10.	Display of paper cuttings and photos on charts	74	66.7	3
11.	Preparation of script magazine in maths	12	10.8	14
12.	Maintenance of wall magazine in maths	21	18.9	13
13.	Contributing maths related books to the school	30	27.03	10
14.	Writing maths related things or completing puzzles in papers/ magazines	25	20	11
15.	Collection of reference material from Journals subscribed by the School	11	9.9	15

From Table 4, it is observed that the frequency of the activities taken up by the students ranges from 9.9% to 80%. The activity **'**preparation of T.L.M by students**'** stood in first and the activity **'**collection of reference material from journals subscribed by the school**'** stood in last. No activity in the list was left with any practice.

From this information, it can be inferred that the students at secondary school level are participating / organizing co-curricular activities in mathematics.

Activities taken up by both teachers and students

Out of the 67 statements given in the check list, 47 are representing the activities taken up by the teachers (S.No. 1 to 26 in the check list), students (S.No. 27 to 41 in the check list), and both (S.No. 42 to 47 in the check list).

In the category *activities taken up by teachers and students*, the statement 'please specify if any other…' (S.No. 47) is an open ended question in response to statements (S.No. 42 to 46) in the check list. No teacher in the sample had answered this statement. Hence, for the remaining five statements - the total responses, percentage and rank were calculated. The information is presented in Table 5, Page 69.

TABLE 5

Activities taken by both teachers and students – Total, Percentage, Rank

S. No	Activity	Total	%	Rank
1.	Celebration of Birth days / death anniversaries of mathematicians	72	65	1
2.	Participation in mathematics fairs outside the school	54	49	2.5
3.	Celebrating important occasions in mathematics	54	49	2.5
4.	Special emphasis on Indian mathematics at school level	13	11.71	4
5.	Cultural programmes relating to mathematics in the form of Play lets / Songs / Dance etc	9	8.11	5

From Table 5, it is observed that the frequency of the activities taken up by both teachers and students ranges from 8.11 % to 65%. The activity 'celebration of birth days / death anniversaries of mathematicians' stood in first and the activity 'cultural programmes relating to mathematics in the form of play lets / songs / dance etc' stood in last. No activity in the list was left with any practice.

From this information, it can be inferred that both teachers and students at secondary school level are participating / organizing co-curricular activities in mathematics.

Also, from table 5, it is observed that birth days and death anniversaries of mathematicians is an activity undertaken by maximum number of schools (72) and it ranks first. It is practical that in all most all schools the birth day of Srinivasa Ramanujan is being celebrated. This could be the reason for first rank.

Further the celebration of birth centenaries of Srnivasa Ramanujan all over the country in 1987, the declaration of 22nd December as 'National Mathematics Day' by the Government of India in the same year and the consequent awareness in teachers and public could also be valid reasons. Celebration of important occasions in mathematics and participation in mathematics fairs outside the school ranks second. Moreover, 13 schools are putting emphasis on Indian mathematics. These results evidently drive focus on to the increased awareness amongst both teachers and students towards activity based learning. The least percentage (8.1) of schools showed interest in the conduct of mathematics related cultural programmes. Probably both teachers and students are relatively ignorant about either the design or conduct of cultural programmes on mathematics, a subject which is supposedly considered to be predominantly involved with cognition. Finally, from the data presented in Table 3, Table 4, and Table 5 it can be inferred that the secondary schools are organizing co-curricular activities in mathematics. Now, to study the level of organization of co - curricular activities in mathematics at secondary level, a four point scale was considered. The detailed description of the scale and result is given in Table 6.

TABLE 6

Level of organizing co-curricular activities – Percentage

S. No	Level of Activity	No .of Schools	%	Description
1.	Up to 11 activities	14	12.61	Less Active
2.	12-22 activities	36	32.43	Moderately active
3.	23-33 activities	33	29.73	Highly active
4.	34-46 activities	28	25.23	Very highly active

From Table 6, it is observed that nearly 13% of secondary schools are less active in conducting mathematics co-curricular activities. Approximately 25% of schools are very highly active in conducting mathematics co-curricular activities. Around 32% of schools are moderately active where as 30% schools are highly active in conducting mathematics co-curricular activities. On the whole, 55% of the sample schools are considerably very active in conducting mathematics co-curricular activities.

RESEARCH QUESTION-2

Popularity of co-curricular activities

What are the different types of activities that are popular?

Out of the 67 statements given in the check list, 47 are representing the activities taken up by the teachers (S.No. 1 to 26 in the check list), students (S.No. 27 to 41 in the check list), and both (S.No. 42 to 47 in the check list). To estimate the popularity of co-curricular activities, activities stood in first five ranks and last five ranks were considered in each category. Information pertaining to the activities taken up by the teachers is presented in Table 7 and Table 8 Page 65 and Page 67.

TABLE 7

Activities taken up by the teachers-First five ranks, %, Rank

S. No	Activity	Total	%	Rank
1.	Preparation of teaching learning material by teachers	105	95	1
2.	Display/demonstration of the models in the school	92	83	2.5
3.	Conduct of mathematics quiz to the class students only	92	82.88	2.5
4.	Conduct of mathematics quiz on special occasions	71	63.96	4
5.	Conducting mathematics exhibition as a part in school science exhibition	59	53.2	5

From the table 7, it is observed that, 95 % of the teachers prepare T.L.M. 83% of the sample teachers conduct mathematics quiz to class students only. 64% of the teachers conduct mathematics quiz on special occasions. And 53% of the teachers conduct mathematics exhibitions as a part of school science exhibition.

The highest percentage i.e. 95 in respect of preparation of T.L.M. may be due to low cost, availability of material, utility of the objects for teaching learning process. Further preparation of T.L.M. is one of the important responsibilities of the teacher. They are considering for evaluation of teacher's performance by the inspecting officers and supervisors. The T.L.M. is a good source for a teacher to elicit learner's interest and draw involvement in the class activity. The managements and Head masters encourage teachers in the preparation of T.L.M. Many teachers involve students in the preparation of T.L.M. as such involvement is a strong motivator.

The fact that 83% teachers conduct mathematics quiz to the class students only reflects that the teacher's commitment towards the achievement of the class. Such quiz competitions help the teachers to strengthen learning. Quiz competitions help the students to generate interest in the subjects among the students.

The success or appreciation received from the teacher in the classroom induces the spirit of competition among students. Resourceful teacher exploit this spirit of competition to encourage the students to achieve higher goals. In this way classroom quizzes helps the teachers to address the individual requirements of the learners in the classroom. Quiz competitions help the teachers to foster team spirit and promote cooperative learning.

Sixty four percent of the teachers take up quiz activities on special occasions. It can be concluded that these activities on special occasions help the teacher to bring to height the social, cultural, historical and intellectual significance of the occasions. This activity further helps other teachers and general public to appreciate the significant place of mathematics in human history and develops a positive attitude towards mathematics subject and learners.

Fifty three percent conduct mathematics exhibition as a part in school science exhibition. After having the significant place of science exhibitions in scholastic activities the analogy carried over to mathematics also. The popularity and recognition bestowed on science exhibitions must have motivated the mathematics teachers to organize mathematics exhibitions also.

The availability of low cost material and electronic gadgets to prepare exhibits must be another important factor that might have motivated mathematics teachers in taking part in mathematics exhibitions.

TABLE 8

Activities taken up by the teachers-Last five ranks, %, Rank

S.No	Activity	Total	%	Rank
1.	Encouraging students to write Mathematics articles to School magazine	19	17.1	22
2.	Conducting separate mathematics exhibition in the school	16	14.4	23
3.	Using computers for T.L.M. in Mathematics	15	13.5	24
4.	Conduct of Workshops / orientation classes for local students	13	11.7	25
5.	Arranging 'Ganita Asthavadhanam'	05	4.5	26

From the table 8, it is observed that 17% of the teachers encourage students to write articles pertaining to mathematics to school magazines. This could be understood because of lack of financial resources for many schools to publish school magazines at regular intervals. Even few schools which publish magazines do it once in a year. Naturally this restricts teachers from encouraging students to prepare articles to school magazines.

Further preparation of articles requires extensive study and research. Most of the schools do not have adequate library facility or the more advanced facility like internet. This again imposes restriction. Another worth mentioning limitation at this point of time is the emphasis on achievement at the yearend examinations or board examinations. This imposes restriction on teachers to encourage students to involve in extensive reading and prepare articles. Most of the time, articles prepared by students do not provide the same amount of gratification as other activities like participation in exhibitions, quiz competitions etc which again reflects in the poor percentage.

Fourteen percent of the teachers conduct separate mathematics exhibitions in schools. Preparing exhibits in mathematics where most of the concepts are abstract in nature is not as easy as preparing exhibits in other subjects like science and social studies. Mathematics exhibition is creative job which requires better sophistication and originality of thought. Further the teacher without mathematics background can not involve in this activity. Hence, the limited number of mathematics teachers has to involve in the preparation of the exhibits. In many schools the mathematics teachers are already over burdened with their regular academic work. So, the time at their dispose is limited to undertake the laborious and time consuming activity of exhibits preparation.

Fourteen percent of the teachers use computers for T.L.M. The main hurdle in the use of computers for T.L.M. preparation is non availability of software in regional language. In most of the government schools teachers are not adequately trained to utilize computers in the preparation of T.L.M. If a teacher wants to use computer generated T.L.M., he requires expensive hard ware equipments like projector, sound systems etc. In most of the schools this equipment is not available. Several administrative restrictions deny access to computers to teachers and students.

Twelve percent of the teachers involve in the conduct of workshops / orientation classes. Our school administrative system is highly hierarchical and many times mathematics is bound by rules, regulations, procedures and administrative protocols. So, the scope for the teacher to organize such activities gets restricted. The 12% noted reflects the involvement of the few teachers who take up such activities on their own informally. As already mentioned the over burdened teachers in highly achievement oriented environment can spare very little time for this activity. This justifies the poor percentage.

Further, from the table 8, it is noticed that **'**Ganita Asthavadhanam**'** is organized by 4% of the sample schools. Necessity of having resourcefulness on the part of the teacher, support from management, and association with other resource persons are some of the expected determinants for this poor percentage / least rank. Further it is observed that only 12% of the sample teachers are conducting workshops / orientation classes for local schools.

Thirteen percent of the teachers are using computers as T.L.M. supporting to their regular class-room teaching. In the process of analyzing the response sheets, the investigator found that among the 15 teachers using computers as T.L.M., 9 members belong to private schools. The other is government schools. It shows that the private sector is more advanced in using advanced technology faster than the Government. This may be because of the flexibility to private management system unlike the rigid government system. Further most of the private teachers are fresh and hence they are more technology oriented.

'Asthavadhanam' is popular and exclusive in Telugu literature and in other fields of human excellence it is rather a new phenomenon. Very rarely we see this activity in 'Bharatha Naatyam' (Mr. Dhara Satyanarayana Sarma is recognized for his Asthavadhanam contribution to 'Naatyavadhaanam'). In a serious subject like mathematics which insists on accuracy and exactness Asthavadhanam is rarer. Further an activity like **'**Ganita Asthavadhanam**'** needs much resourcefulness on the part of the teacher. It also requires plenty of human and other resources. This could be the possible reason for the low percentage. Asthavadhanam requires the active involvement of at least 10 individuals namely, one Avadhani, 8 experts who probe the Avadhani through various forms of Avadhanam techniques (Prichhakas) and one moderator. All these individuals are to be invited from different parts of the state or country. It is a highly expensive activity even if the component of remuneration is omitted. Traveling, boarding and lodging expenses will be considerable. Schools with limited resources cannot meet such a huge expenditure.

ACTIVITIES TAKEN UP BY THE STUDENTS

Out of the 67 statements given in the check list, 47 are representing the activities taken up by the teachers (S.No. 1 to 26 in the check list), students (S.No. 27 to 41 in the check list), and both (S.No. 42 to 47 in the check list). To estimate the popularity of co-curricular activities, activities stood in first five ranks and last five ranks were considered in each category. Information pertaining to the activities taken up by the students is presented in Table 9 and Table 10, Page 76 and Page 77.

TABLE 9

Activities taken up by the students-First five ranks, %, Rank

S. No	Activity	Total	%	Rank
1.	Preparation of Teaching - Learning material by Students	89	80	1
2.	Collection of mathematics related news paper cuttings	80	72.07	2
3.	Display of paper cuttings and photos on charts	74	66.7	3
4.	Preparation of scrap books	57	51.4	4
5.	Participation in mathematics fairs outside the school	54	49	5

From Table 9, it is clearly evident that the preparation of Teaching- Learning Material (T.L.M.) by students is taken up in 89 secondary schools out of the total sample 111 schools and ranks first. A more positive tendency in the preparation of T.L.M. may be the reason for this priority. This suggests the coincidence with the results in table 9 that the activities taken up by the teachers, where in the preparation of T.L.M. contributed to the highest percentage. The importance given in teacher training programme, during inspections, external and internal observations and their class room utilitarian value could be the possible reasons for their high rank.

It is further inferred that collection of mathematics related news paper cuttings, display of paper cuttings and photos on charts and preparation of scrap books rank 2^{nd}, 3^{rd} and 4^{th} respectively. The investigator observed an evident coincidence of the research results with that of the natural phenomena in schools under the same order of hierarchy. Students find it much easier and interesting to take up the activity of cutting mathematics related material and display them effectively on charts and scrapbooks etc. Participation in mathematics fairs outside the school ranks fifth, probably because it involves higher level of performance skills and expenditure.

TABLE 10

Activities taken up by the students-Last five ranks, %, Rank

S. No	Activity	Total	Percentage	Rank
1.	Writing mathematics related things or completing puzzles in papers/ magazines	25	20	11
2.	Undertaking mathematics project works	22	19.8	12
3.	Maintenance of wall magazine in mathematics	21	18.9	13
4.	Preparation of script magazine in mathematics	12	10.8	14
5.	Collection of reference material from journals subscribed by the School	11	9.9	15

From Table 10, either writing mathematics articles or completing puzzles in magazines is an activity that was undertaken by 25 schools only and it ranks 11^{th}.The inherent abstract nature of the subject mathematics, rare appearance of articles pertaining to mathematics in popular journals and magazines, the general apathy of the public towards such contributions, the prevailing belief that such articles are meant for specialists in the subject could be the possible reasons to the low ranks to the items mentioned in Table 10.

Further, from Table 10, it is further found that undertaking projects in mathematics ranks 12. Non-emphasis on the part of the teachers and lack of right perspective on the part of students about the conduct of project works in mathematics may be the reasons for this less preference. Further, the current mathematics text books of secondary schools of Andhra Pradesh rarely have project works appended to chapters. Most of the students feel that the project works have no relevance to their achievement at the yearend or board examinations. Hence, they take them along with co-curricular activities and neglect.

A change in the trend is emerging with the introduction of projects in the 3rd and 4th class mathematics text books which are introduced during the academic year 2009-2010. It can be assumed that the future text books of secondary schools will also carry projects appended to various chapters. However, students can be motivated to take project seriously if they are also included in the final evaluation procedures. It is further found that, maintenance of wall magazine and script magazine ranks 13 and 14 respectively. Collection of reference material from Journals stood in 15th rank. It shows that, subscribing journals is the least preferred activity in schools. Subscribing to the journals and procuring them to the school libraries involve huge expenditure. The available special fees funds are utilized for daily news papers only. In the absence of special grants it is difficult for the schools to subscribe journals.

RESEARCH QUESTION-3

Existence and organization of mathematics club

Are the secondary schools organizing mathematics clubs?

Basing on the information from Part-A of the check list, the existence and organization of mathematics club is recorded in Table 11 and 12, Page 78 and 79.

TABLE 11

Existence of mathematics club – Total, Percentage

S.No	Variable	Number of Schools	%
1.	Yes	39	35.14
2.	No	72	64.86
	Total	**111**	**100**

From Table 11, it is observed that only 35% secondary schools have mathematics clubs. The other 65% schools do not have such arrangements. Further it is observed that, even after 23 years from the day of recommendations made by *National Policy on Education 1986* on the need of having a mathematics club in secondary schools, the present percentage of existence of mathematics clubs in secondary schools is 35 only.

Even though all the 111 secondary schools are conducting co-curricular activities, only 39 schools are conducting the activities through mathematics clubs. The information about the organization of these clubs (in years) is presented in Table 12.

TABLE 12

Organizing mathematics club (in Years) – Total, Percentage

S.No	Variable	Number of Schools	Percentage
1.	Below 5 years	23	58.98
2.	5-10 years	08	20.51
3.	10-15 years	03	7.69
4.	15-20 years	02	5.13
5.	Above 20 years	03	7.69
	Total	**39**	**100**

From Table 12, it is observed that nearly 59% of the secondary schools are organizing mathematics club activities during the last five years. It indicates that, having a mathematics club is a recent phenomenon. Around 21% of the schools are running mathematics club during that last 5-10 years and 8% of the schools are running mathematics clubs during the last 10-15 years. It is observed that only 8% of the schools are running mathematics clubs since last 20 years. Out of these three schools two are government aided and one is Zilla Parishad high school. The support from management, resourcefulness, personal interest of the teachers and the positive attitude towards mathematics clubs may the reasons for this long standing existence.

RESEARCH QUESTION-4

Resources for conducting co-curricular activities

D. ***What are the financial resources relating to conduct of co-curricular activities in mathematics?***

E. ***What are the academic resources relating to conduct of co-curricular activities in mathematics?***

F. ***What are the infrastructural facilities relating to conduct of co-curricular activities in mathematics?***

Out of the 67 statements given in the check list, 47 are representing the activities taken up by the teachers (S.No. 1 to 26 in the check list), students (S.No. 27 to 41 in the check list), and both (S.No. 42 to 47 in the check list). This completes Part-B of the check-list. Part-C of the check list covers the areas financial support (S.No. 48 to 56 in the check list), academic support (S.No. 57 to 60 in the check list) and infrastructural facilities for organization of co curricular activities (S.No. 61 to 67 in the check list). Responses under these three categories are enlisted in Table 13, Table 14 and Table 15 in Pages 80, 82, and 83 respectively.

Financial support

The information pertaining to financial support is presented in Table 13.

TABLE 13

Financial support- Total, Percentage

S. No	Activity	Total	%
1.	Support from management	54	49
2.	Funds from special fee	36	32
3.	Contribution from staff members	37	33.3
4.	Contribution from students voluntary	35	31.53
5.	Contribution from old students/parents	14	12.6
6.	From any sponsoring agency/donors	11	9.91
7.	Support from local mathematics associations	5	4.5
8.	Support from local schools	6	5.4
9.	Collection of separate fee from students	12	10.8

Table 13, gives an inference about the financial support that assists the conduct of activities in schools. Fifty four schools out of 111 schools that contribute to a maximum of 49% are observed to be supported by the management. Funds from special fee (32%), contribution from staff members (33%) and voluntary contribution from students (32%) are occupying more or less an equal status in smooth functioning of the co-curricular activities in mathematics.

Old students and parents contribute just 13% to provide financial support to mathematics co-curricular activities. In a country like India with minimum per capita income it is difficult to enlist financial support from parents or old students. In this connection it can be assumed that with the increasing per capita income alumni come forward to support the school. Already there is a trend in several parts of Andhra Pradesh where alumni are coming forward to provide classrooms, furniture etc.

In the same way their support can be enlisted to develop mathematics club activities also in due course. It is seen that 10% support is received from sponsoring agencies / donors. Many sponsoring agencies are utilizing funds to provide basic facility to the students like uniform, books etc. With the development of economy it can be assumed that the percentage of people who come forward to support mathematics club activities will increase.

Support from local mathematics associations is just 5%. As a matter of fact mathematics associations are very few in the state of Andhra Pradesh. Even among those few associations a good number of them are supported and organized by few individuals. The human vagaries and fancies always dominate almost all the associations and there is no exclusion for mathematics associations. This result in selection and in utilizations of funds or providing support i.e. the association respond selectively. Even though this is not good enough in academic activities it is to be accepted. Hence, the low percentage occurred.

Moreover, from Table 13 is observed that, 11% of the schools collect separate fees from students. Private educational institutions are free to collect different types of fees under different heads. However, schools which are under the control of the Government are prohibited from compulsory collections. Even if an enthusiastic teacher or head master resorts to such type of collections, they become answerable to higher authorities. No Government teacher invites such a situation. This could be the reason for low percentage.

Academic support

Part-C of the check list covers the areas financial support (S.No. 48 to 56 in the check list), academic support (S.No. 57 to 60 in the check list) and infrastructural facilities for organization of co curricular activities (S.No. 61 to 67 in the check list). The information pertaining to academic support is presented in Table 14.

TABLE 14

Academic support – total, Percentage

S. No	Activity	Total	%
1.	Staff members	80	72
2.	Local mathematics associations	13	12
3.	Local schools	11	9.9
4.	Resource persons	22	19.82

From Table 14, it is observed that 72% of staff members provide academic support for co-curricular activities in mathematics at secondary schools. It indicates that co-curricular activities in mathematics attract adequate support from staff members. This is an appreciable trend because it caters to one of the main objectives of education i.e. holistic approach.

Further, the involvement of majority of staff members in co-curricular activities promotes team spirit and cooperation in school activities. Local mathematics associations contribute to 12% of academic support to co-curricular activities in mathematics at secondary school level. As already mentioned non-commercial, voluntary professional, academic bodies like mathematics are very rare in Andhra Pradesh. Hence, the low percentage can be understood. It is seen that co-curricular activities in mathematics at secondary school level receive 10% support from local schools. This can be understood from the fact that the number of teachers in mathematics subject in any school are less than 15% of the staff available on roll in that institution. With this limited staff support any school cannot stretch a hand of support to other schools.

In addition to that there always exists local competition among neighboring institutions in all academic matters. Though this competition is wanted, one of its side effects is the reservedness of the teacher towards the activities in other schools. The contribution to co-curricular activities in mathematics in secondary schools is 20%. These resource persons are the individuals who are not regular teachers but interested to contribute their mind for mathematics. Many of these resource persons are from different walks of life and most of them are employed in fields (banks, marketing etc.,) which are not directly connected to school. This interest from other people is an indication of the aesthetic value of mathematics. It can be understood that people are ready to enjoy mathematics like cultural arts such as music, literature etc. People with this voluntary involvement attitude are a boom to the co-curricular activities in mathematics and mathematics teachers must come forward to utilize this local support for improvement of co-curricular activities in mathematics.

Infrastructural facilities

Part-C of the check list covers the areas financial support (S.No. 48 to 56 in the check list), academic support (S.No. 57 to 60 in the check list) and infrastructural facilities for organization of co curricular activities (S.No. 61 to 67 in the check list). The information pertaining to infrastructural facilities is presented in Table 15.

TABLE 15

Infrastructural facilities – Total, Percentage

S.No	Activity	Total	%
1.	Separate room	32	29
2.	Stationary	57	51
3.	Power supply	52	46.8
4.	Computers	47	42.34
5.	Internet	19	17.1
6.	Preservation facilities for the models in the school	23	20.72

From Table 15, it is observed that 51% of schools have stationary availability to organize co-curricular activities in mathematics at secondary school level. Stationary includes low cost material like boards, pencils, charts, drawing colors etc. Most of these items are not expensive.

So, their cost effect may be the reason for the high percentage. These items are supplied by students and they are useful in day to day classroom activities. 47% of the schools have power supply, 42% of schools have computers and 17% of schools have internet facility. These three are interlinked items.

Most of the Government schools function with meager funds and electricity bills come under recurring expenditure item. Maintenance of power supply lines and other installation costs add to overhead cost. Hence, the low percentage with respect to power supply could be understood.

Forty two percent of schools have computers but majority of them are private schools. Availability of computers is still in its nascent stage in most of the Government schools. The systems are expenditure on one hand, and the needed software is not available in regional language.

This imposes insurmountable restrictions on the teachers to utilize computers for co-curricular activities in mathematics. Again, only 19% of schools have internet facility. Technology based educational activities are making entry in our secondary schools very recently. Hence, no further inferences can be drawn on this facility.

Twenty nine percent of schools have separate rooms and 21% have preservation facilities i.e. 50% of the schools have infrastructural facilities at least to some extent to preserve the material pertaining to co-curricular activities in mathematics.

It can be said that the secondary schools are much below the half a mark in providing infrastructural facilities for mathematics lab as recommended by several educational commissions on the policy papers.

RESEARCH QUESTION-5

Affect of demographic variables

E. Does the type of the school influence the existence of mathematics club?

F. Does the sex of the in charge of co-curricular activities influence the conduct of co-curricular activities in mathematics?

G. Does the teaching experience of the teacher influence the conduct of co-curricular activities in mathematics?

H. Does the experience as an in charge of the activities influence the conduct of co-curricular activities in mathematics?

Information regarding type of management of the school, sex of the in charge of the mathematics club / activities, teaching experience of the in charge teacher and the experience as an in charge on the activities was collected from Part-A of the check list. The details were presented in Table 16, Table 17, Table 18 and Table 19 in Page 79, Page 80 and Page 81.

Type of Management

The information regarding the type of management of the school is presented in Table 16.

TABLE 16

Type of Management – Total, Percentage

S.No	Type of management	Total	%	Existence of mathematics club			
				Yes	%	No	%
1.	Government *	67	60.36	27	40.29	40	59.70
2.	Private aided	11	9.91	5	45.45	6	54.54
3.	Private Unaided	33	29.73	7	21.21	26	78.78
	Total	**111**	**100**	**39**		**72**	

***** Municipal schools are included in this category

From Table 16, it is observed that the percentage (nearly 46%) of existence of mathematics clubs is high in case of private aided schools when compared with Government and private unaided schools. The positive attitude of teachers working in aided schools towards organizing mathematics clubs and the prolific support from their respective managements may be the reason for this high percentage.

In case of Government schools the percentage of existence of mathematics club is nearly 41, and this is nearly 21% in case of private unaided schools. It is generally expected that the private schools are rich in case of resource persons, infrastructural facilities and even in financial aspects. But, the observed percentage (21) existence of mathematics clubs is very poor. Highly marks oriented system education, unhealthy competition among private / corporate schools may be the reasons for this low percentage.

TABLE 17

Sex of the in-charge of the club / activities – Total, Percentage

S.No	Variable	Number of Teachers	%
1.	Male	84	75.67
2.	Female	27	24.33
	Total	**111**	**100**

From Table 17, it is observed that 76% of men teachers, and 24% of the women teachers are acting as in-charges of mathematics club activities. In view of the in-adequate size of the sample, no further conclusions are drawn.

The low percentage of literacy particularly among women, the social prejudices against women involving in serious subjects like mathematics could be the possible reasons. However, the role of the variable ‘sex’ in the organization of mathematics club activities needs further investigation.

TABLE 18

Teaching experience – Total, Percentage

S.No	Variable	Number of Teachers	%
1.	Less than 5 years	15	13.51
2.	5-10 years	27	24.32
3.	10-15 years	31	27.93
4.	15-20 years	19	17.12
5.	Above 20 years	19	17.12
	Total	**111**	**100**

From Table 18, it is observed that 28% of the teachers have 10-15 years of teaching experience. 25% of teachers have 5-10 years of teaching experience. Fourteen percent of the teachers have experience of less than 5 years. Teachers with 15-20 years and above 20 years of experience constitute 17 % of each category.

TABLE 19

Experience as an in charge – Total, Percentage

S.No	Variable	Number of Teachers	Percentage
1.	Less than 5 years	24	21.62
2.	5-10 years	03	2.70
3.	10-15 years	07	6.31
4.	15-20 years	00	0
5.	Above 20 years	01	0.90
6.	Not an in-charge	76	68.47
	Total	**111**	**100**

From Table 19, it is observed that 68% of the sample teachers undertake co-curricular activities in mathematics though they are not holding in-charge position of respective school's mathematics club. In contrast a negligible percentage of 'one' among the in-charge of the clubs take up mathematics club activities. These two extreme positions are to be attributed to personal interest and positive attitude of the sample teachers towards mathematics clubs.

4.4. FINDINGS

1. All the secondary schools are conducting more or less co-curricular activities in mathematics. No school is left without any practice.
2. Fifty five percent of secondary schools are considerably very active in conducting co-curricular activities in mathematics.
3. Preparation of teaching learning material is highly rewarded co-curricular activity (95%) that was taken up by the teachers in secondary schools.
4. Only 5% of schools are aware of creative and innovative activities like **'**Ganitha Asthavadhanam**'**.
5. Secondary school students are also giving top priority (80%) for the preparation of teaching learning material.
6. Even though 80% of secondary school students are involving in the preparation of teaching learning material, other activities like preparation of script magazine and collection of reference material are limited to 10% only.
7. Even though mathematics is considered as a prime subject in secondary schools, only 35% of schools are having mathematics clubs which form the nucleus for co-curricular activities in mathematics.
8. Nearly 59% of secondary schools are organizing mathematics clubs during the last five years. It indicates that, having a mathematics club is a recent phenomenon.
9. There is a dearth of financial and other support to the mathematics clubs to take up activities.
10. Mathematics club need academic support also from Resource centers, Mathematics Associations and other Voluntary and Statutory bodies.
11. Mathematics clubs needs adequate infrastructural facilities and technical support.
12. Only 40% of Government schools have mathematics clubs to organize co-curricular activities in mathematics where as 46% of private aided and 21% of private unaided schools have mathematics clubs.
13. With respect to the type of management of schools, particularly the Government sector is not extending the necessary support to teachers and schools to organize mathematics club activities.

14. Out of the total (39) schools with mathematics clubs, only 24% female teachers take part in co-curricular activities, where as 76% male teachers taking part in the same respect i.e. Female teachers are involving in mathematics club activities in lesser number where as male teachers participate in more number.
15. Teachers with 15-20 years and above 20 years of experience are involving more actively in conducting co-curricular activities than other. It indicates the gigantic experience is a favorable factor towards involvement in co-curricular activities in mathematics.
16. Sixty eight percent of the teachers in secondary schools are undertaking co-curricular activities in mathematics though they are not holding in-charge position of respective school's mathematics club. It indicates that personal interest and positive attitude towards organizing mathematical co-curricular activities is very crucial than any other factor.

CHAPTER – 5
SUMMARY, FINDINGS AND SUGGESTIONS

The mind uses its faculty for creativity only when experience forces it to do so. *– Poincare, J.H.*

5.1. INTRODUCTION

It in now realized that the function of education is to bring change in child behavior and personality in a more desirable form. Development of child's body and mind demand proper nurturing of its physical and intellectual qualities as few of the major determinants of his personality. Therefore, modern approaches of education emphasize on all round development of the child.

The process of education is not something static or one time measure rather, continuous and lifelong endeavor that can be divided in two parts; curricular activities and co-curricular activities. These are also recognized as a source of enrichment and vitalization of the school curriculum, mainly through the cultivation of hobbies, interests, etc. these activities are no longer looked upon as extras but as an integral part of the school programme.

Co-curricular activities, as the name implies, are those, not directly related with the prescribed curriculum and include; sports, athletics, scouting, cubing, various hobbies, excursions literary societies, dramatics, debates etc. to bring social and physical adjustments in the child. Co-curricular activities help to develop the all-round personality of the students to face the undaunted task and turbulent world of future. The aim of co-curricular activities is to make the students fit for the future time and to develop a sense of competitive spirit, co-operation, leadership, diligence, punctuality, and team-spirit as well as to provide a backdrop for the development of their creative talents. As the secondary school has obligation to provide pupils with opportunities to explain widely their life, it should contain mathematics as one of the compulsory subjects in its curriculum.

The importance of mathematics in the real world should be reflected in the secondary schools. It should preserve and propagate the right place of mathematics as it is one of the compulsory subjects of secondary education. It is said that, ***'Mathematics and languages are meat and potato of the educational diet of the people'.*** The reason for the important place of mathematics at secondary school level is, without the knowledge of mathematics a person will be unable to cope with his day to day life as he has to apply it in each and every aspect such as agriculture, health, household accounts, measurement etc.

In Service Teacher Education Package, Module 27 stated that the teaching of mathematics in majority of the schools is far from satisfactory. The rate of failures in mathematics is considerably higher than in other subjects. Many pupils find mathematics a difficult subject whatever be the reason for this attitude.

The *National Policy on Education, 1986 (N.P.E.)* identified strengths and weaknesses of the system of education and clearly enunciates the direction for re-shaping the system at school level. There is a specific mention in the it about mathematics education in the following words-***'Mathematics should be visualized as a vehicle to train a child to think, reason, analyze and articulate logically apart from being a specific subject'.***

The inherent abstractness of the grand subject mathematics makes it less attractive to an average learner. Further mathematics demands more hypothetical situations which young students cannot realize in a class-room. This makes the subject altogether difficult. A resourceful mathematics teacher can make use of a good number of methods and techniques for arousing and sustaining interest in mathematics. Learning mathematics in an informal way through recreational and fun filled activities is an important means of non formal mathematics education.

Mathematics provides ample opportunities for fun and recreation. Mathematical games and puzzles open up avenues for learning mathematics in a lucid and relaxed manner. The teacher of mathematics can provide a variety of unfilled activities that could sustain the student's interest and promotes student's mathematical learning.

5.2. NEED FOR THE STUDY

In mathematics teaching, a teacher's effort in executing student centered instructional strategies can be seen through the conduct of co-curricular activities by him/her, which in turn influences the participation of student's in learning the subject.

So making the teachers aware of co-curricular activities and trying to stimulate this faculty in them are two essential and useful things. Any attempt in this direction enables us to know the levels of organizing ability of the teachers in secondary schools. If a research work is taken up with the assumptions concerning the organization of co-curricular activities in mathematics; it will be highly beneficial to those who are in the field of education. Hence the study is taken up on secondary school teachers.

5.3. STATEMENT OF THE PROBLEM

"A STUDY OF THE ORGANIZATION OF MATHEMATICAL CO-CURRICULAR ACTIVITES IN SECONDARY SCHOOLS"

5.4. OPERATIONAL DEFINITIONS

Co-curricular activities

Activities taken up by both teachers and students, supporting to their teaching-learning process along with their regular class room practices, not interrupting the academic results in a secondary school are here considered as co-curricular activities.

Secondary school

A school running academic classes for 6^{th} to 10^{th} class students is here after considered as a secondary school.

5.5. OBJECTIVES OF THE STUDY

This investigation proposed to conduct with the following objectives

6. To study the level of organization of co-curricular activities in mathematics in secondary schools.
7. To study the popularity of different types of co-curricular activities those are conducted in mathematics at secondary school level.
8. To study the organization of mathematics clubs at secondary school level.
9. To find out the resources for the organization of co-curricular activities in mathematics at secondary school level.
10. To study the effect of demographic variables of teachers in conducting co-curricular activities in mathematics.

5.6. RESEARCH QUESTIONS

In order to carry out the investigation along the lines of these objectives for guidance of action, instead of research hypotheses, research questions framed, as the objective of the study is fact-finding.

I) Level organization of co-curricular activities

Are the Secondary schools organizing co-curricular activities in mathematics? If yes, at what level they are organizing?

II) Popularity of co-curricular activities

What are the different types of activities that are popular?

III) Existence and organization of mathematics club

Are the secondary schools organizing mathematics clubs?

IV) Resources for conducting co-curricular activities

G. What are the academic resources relating to conduct of co-curricular activities in mathematics?
H. What are the financial resources relating to conduct of co-curricular activities in mathematics?
I. What are the infrastructural facilities relating to conduct of co-curricular activities in mathematics?

V) Effect of demographic variables

I. Does the type of the school influence the conduct of co-curricular activities in mathematics?
J. Does the sex of the in charge of co-curricular activities influence the conduct of co-curricular activities in mathematics?
K. Does the teaching experience of the teacher influence the conduct of co-curricular activities in mathematics?
L. Does the experience as an in charge of the activities influence the conduct of co-curricular activities in mathematics?

5.7. LIMITATIONS

6. The study is limited to the geographical area of Krishna district in the state of Andhra Pradesh
7. The study is limited to the Secondary schools established up to the academic year 2006-2007 in Krishna district of Andhra Pradesh
8. Only one tool is administered to one school, since the nature of the tool is to observe the conduct of co-curricular activities in that particular school
9. Only descriptive statistics are taken up
10. Dimension wise analysis of the tool was not taken up

5.8. REVIEW OF RELATED LITERATURE

In the present study, a review of related literature has yielded very rich dividends. It gave very clear insight into the study area enabling the investigator to define the objectives, the scope, measurement and methodology.

Lisa Wilson Carboni and Susan N. Friel (1996) studied on *'Using Instructional Videotapes in an Elementary Mathematics Methods Course.'* They found that the pre-service teachers viewed the videotapes as offering worthwhile learning experiences, suggesting that the use of videotapes can help instructors move students with different orientations in intended directions.

Narasimharao, B.V.L. (1997) studied the *attitudes of school children towards mathematics fairs*. He found that no significant difference is seen in the attitudes of boys and girls towards mathematics fairs.

Shakila J. (2000) conducted a *study of participation of IX class students in co-curricular activities of Mathematics in Guntur city.* She concluded that opportunities for mathematical activities are found to be more. Further she found that the students' participation in co-curricular activities of mathematics is found to be moderate extent. Heterogeneous participation of students is found in mathematical activities.

Natesan, N. (2001) in his study on *'Teaching Concepts in Mathematics through Video Cassette – An Experiment'* found that the increment in the level of academic achievement of experimental group was due to the teaching of mathematical concept through video-cassette. He further observed that there was a significant difference between boys and girls in all groups.

Athipenr; C.P. (2002) in his study on *Impact of using simple techniques in mental arithmetic* found that

- using simple techniques in mental arithmetic has increased the speed and accuracy of class VI pupils.
- there is no significant difference either among boys and girls or among rural and urban pupils in the speed and accuracy in doing mental arithmetic.

Sarala, Duvvuri (2002) in her study on the *functioning of mathematics clubs in colleges of education in Andhra Pradesh* found that

- Sixty seven percent of the colleges of education have mathematics clubs.
- Sixty nine percent of the club conveners have more than 5 years of teaching experience and the remaining 31% have less than 5 years of experience.
- Celebration of birth days and death days of mathematicians and conducting mathematics quiz to the teacher trainees were the most popular activities organized by the mathematics clubs. The percentage of these activities was 92.
- Arranging lectures by eminent6 persons and helping in the development of mathematics laboratory were the next popular activities (86%).
- The items that got lowest percentage (23%) were administering word search, preparing script magazine, and arranging 'Ganita Astavadhaanam'
- Participating in the mathematics quiz organized by other colleges of education was organized by 63% of the clubs as the second highest activity under the external activities category.
- Eighty seven percent of the mathematics clubs in colleges of education were self financing i.e.the teacher-trainees subscribing for the club.
- With regard to the academic support to the Mathematics club, 64% of the clubs were received from faculty members other than the club convener.
- Only 12% of the mathematics clubs in colleges of education received financial support from local schools and 6% of the clubs received support from any sponsoring agency.

Ipek, A.Sabri & et. al. (2004) in their study on *'the Role of visualization approach on student's conceptual learning'* concluded that in visualization approach students can perceive relations between abstract concepts and semi-concrete structure and make sense of abstract concepts in mathematics, and thus this approach facilitates student's understanding abstract concepts. They further found that visualization must be used both a tool and an aim in mathematics education.

Ismaț Ara and Rakhsi Saleem (2005) in their study oṇ *Role of Co-Curricular Activities: Survey of the Perceptions of Stake Holders (Case Study of Peshawar District)* found that most of the schools have the facilities of co-curricular activities of one kind or the other and the schools also provide their students opportunities to participate in them. It was also found that only 60 % schools provide some portion of funds required for the arrangement of co-curricular activities whereas, in 40 % schools administration does not lend any financial support in arranging such activities.

Gayathri, S (2006) in her study on *'Multimedia Usage by Mathematics Teachers'* concluded that the mathematics teachers in schools affiliated to C.B.S.E. in Bangalore city showed a remarkable evidence of highly favorable attitude towards multimedia usage.

5.9. METHODOLOGY

Methodology is the description of techniques and procedures adopted in research study. The success of a research study depends upon the suitability of methods adopted. The problem for this investigation in first section needs the assessment of co-curricular activities conducted at secondary school level. In the second stage, the supporting activities like academic assistance, financial support, and infrastructural facilities are to be assessed. Hence, this study comes under **'Descriptive research'.**

5.10. TOOL USED FOR THE STUDY

Check list was prepared as a tool for the present investigation. It was prepared after having continuous discussions with eminent persons in the field of mathematics education and experts in conducting co-curricular activities in mathematics at secondary school level. Thus, the tool has expert validity.

5.11. POPULATION

In any statistical investigation, the interest usually lies in studying the various characteristics relating to items or individuals belonging to a particular group. The group of individuals under the study called the population or universe. By population in a research project means the aggregate or totality of objects, subjects or individuals regarding whom the inferences are to be done. Under this study, the investigator considered the entire secondary schools in the district of Krishna as sample for the study. As per the data of the District Educational Officer, Machilipatnam there were 676 secondary schools in the year 2007. These 676 schools form the entire population.

5.11.1. SELECTION OF THE SAMPLE

As it is difficult to study the entire population, the investigator selected a sample out of the total population. As per the statistical data taken from the District Educational Officer, Krishna district–the district Krishna was divided in to five educational divisions and each one is headed by a Deputy Educational Officer (Dy.E.O). These are Machilipatnam, Vijayawada, Nandigama, Nuzivid and Gudivada. In each of these divisions there are 145, 173, 102, 132 and 124 secondary schools are running at present respectively.

By random sampling method the investigator selected 70 schools from Machilipatnam division, 85 from Vijayawada division, 53 from Nandigama division, 60 from Nuzivid division and 65 schools from Gudivada division. Hence, a total of 333 schools were selected for observation. Out of these schools, the investigator distributed the tool to 102 schools personally and to 231 schools by post. With in a week he received 63 filled tools in return by post in total. After giving continuous reminders to the rest of the schools, only 26 filled tools came back. The investigator continued the same procedure to get back the tools. At last 29 filled tools came in return. The remaining was not yet received. With this the investigator got a total of 118 filled tools in final.

Out of these, after verification 7 tools were found not properly filled. Hence they were removed from list. At last, only 111 schools constituted the ***final sample***. To get back information relating to items in the tool, the respondents were requested to furnish the same.

The pertaining items are printed in Page No. 2 and 3 of the tool. The respondents were requested to put a tick mark **'✓'** against a particular activity if the activity was taken up by the club and to put a **'X'** mark otherwise.

5.12. SCORING PROCEDURE

After receipt of the filled in check list, scoring procedure was adopted by the investigator. The investigator noted the **'✓'** mark responses as that activity was taken up by the particular teacher / school and **'X'** mark responses were treated as that activity not taken up by them. The data obtained from such scoring of the filled in tools was tabulated.

5.13. RELIABILITY AND VALIDITY

The tool used for the present study is a checklist. This was prepared after having thorough study on co-curricular activities in mathematics and various co-curricular activities suggested by various authors.

Hence, the tool has content validity. Moreover, the tool was prepared after having thorough discussions with distinguished persons in the field of mathematics education and proficient in conducting co-curricular activities in mathematics at secondary school level. Hence, by nature itself the tool has expert validity. As a whole, the tool has both content and expert validity.

Moreover, the tool used is checklist and the objective of the present study is fact-finding, no attempt made to establish reliability and other types of validity.

5.14. STATISTICAL TREATMENT OF THE DATA

The objective of the study is fact finding, related to the organization of mathematical co-curricular activities in secondary schools. For this five research questions were formulated. The statements in the check list were categorized under the five research questions. The ***total*** responses and ***percentages*** for each statement were calculated. The statistical measure ***rank*** was also calculated where ever applicable.

5.15. FINDINGS

17. All the secondary schools are conducting more or less co-curricular activities in mathematics. No school is left without any practice.
18. Fifty five percent of secondary schools are considerably very active in conducting co-curricular activities in mathematics.
19. Preparation of teaching learning material is highly rewarded co-curricular activity (95%) that was taken up by the teachers in secondary schools.
20. Only 5% of schools are aware of creative and innovative activities like **'**Ganitha Asthavadhanam**'**.
21. Secondary school students are also giving top priority (80%) for the preparation of teaching learning material.
22. Even though 80% of secondary school students are involving in the preparation of teaching learning material, other activities like preparation of script magazine and collection of reference material are limited to 10% only.
23. Even though mathematics is considered as a prime subject in secondary schools, only 35% of schools are having mathematics clubs which form the nucleus for co-curricular activities in mathematics.
24. Nearly 59% of secondary schools are organizing mathematics clubs during the last five years. It indicates that, having a mathematics club is a recent phenomenon.

25. There is a dearth of financial and other support to the mathematics clubs to take up activities.

26. Mathematics club need academic support also from Resource centers, Mathematics Associations and other Voluntary and Statutory bodies.

27. Mathematics clubs needs adequate infrastructural facilities and technical support.

28. Only 40% of Government schools have mathematics clubs to organize co-curricular activities in mathematics where as 46% of private aided and 21% of private unaided schools have mathematics clubs.

29. With respect to the type of management of schools, particularly the Government sector is not extending the necessary support to teachers and schools to organize mathematics club activities.

30. Out of the total (39) schools with mathematics clubs, only 24% female teachers take part in co-curricular activities, where as 76% male teachers taking part in the same respect i.e. Female teachers are involving in mathematics club activities in lesser number where as male teachers participate in more number.

31. Teachers with 15-20 years and above 20 years of experience are involving more actively in conducting co-curricular activities than other. It indicates the gigantic experience is a favorable factor towards involvement in co-curricular activities in mathematics.

32. Sixty eight percent of the teachers in secondary schools are undertaking co-curricular activities in mathematics though they are not holding in-charge position of respective school's mathematics club. It indicates that personal interest and positive attitude towards organizing mathematical co-curricular activities is very crucial than any other factor.

5.16. EDUCATIONAL IMPLICATIONS

The findings of the study and the conclusions drawn helped the investigator to suggest the following educational implications.

- Co-curricular activities in mathematics are to be made integral part of mathematics education
- Teachers in government sector are to be involved in the organization of co-curricular activities in mathematics by making these activities as a part of their job chart.
- Awareness programmes are needed to encourage more women to study mathematics at degree level and take up mathematics teaching to diminish the gender disparity.
- Teachers are to be encouraged to acquire higher professional qualifications through In-service professional advancement programmes.
- Creative and innovative Co-curricular activities in mathematics like 'Ganitha Astavadhanam', Ballets, and Dramas are to be popularized through electronic media and Tele school programmes to motivate more teachers to implement those activities.
- District and state level statutory bodies are to be promoted to plan, to implement and to coordinate Co-curricular activities in mathematics as it is done in Science.
- A fixed proportion of the special fees amount is to be allocated to the mathematical co-curricular activities.
- Infrastructural facilities like computers, L.C.D. projectors and other Audio visual equipment are to be provided to the schools at subsidized prices.
- Tax exemption under 80(G) of IT act can attract more funds for co-curricular in mathematics.
- Teachers have to be trained to utilize technological gadgets in the teaching learning process of mathematics.

- There is a need to promote mathematics clubs and encourage mathematics club activities in the entire secondary schools par with science and literary clubs.
- Mathematics clubs require administrative and academic support from the school education department to plan and implement training programmes to mathematics teachers, conduct exhibitions and carry out other activities. This facility is already available to science subject.
- There is a need to draw more and more women teachers and involve them in mathematics club activities as nearly 50% of the student community are girl students and more than 35% of teaching community are women teachers.
- Teachers are to be encouraged to enhance their professional qualifications which boost their self esteem. They are to be encouraged to integrate technology in mathematics club activities by providing training through organizations like 'Association for Vedic mathematics' (Rurke University) and Inter Ed Tech programmes.
- Even though chronological seniority is to respected interest in the subject and involvement in the activities are also to be considered while entrusting mathematics club activities.
- Schools are to encourage diversifying mathematics club activities to cater to the divergent needs of the learners like preparing models, exhibits, organizing exhibitions, solving puzzles etc.
- There is a need to popularize emerging trends in mathematics subject also to ease the inherent serious nature of the subjects and provide pleasant learning experiences.
- Administrative steps are needed to provide financial support mathematics clubs for their maintenance by allocating a specific percentage of fees collected by the institutions or grants released to the institutions for mathematics club activities.
- A district level mathematics resource centre may be initiated to provide academic and technical support to the different mathematics clubs functioning in various schools.
- Apart from government schools and statutory glands, schools are to be encouraged to generate separate help from local organizations and general public.

5.17. SUGGESTIONS FOR FURTHER RESEARCH

The investigation yielded some interesting results which need further consideration, though they have no direct relation to the original hypotheses. They are enlisted as…

- The frequency of the organizing activities may also be considered as a variable.
- The attitudes of the teacher trainees towards mathematics clubs can be studied.
- The experience of the club convener, his / her attitudes towards mathematics club and the time he/she can utilize for mathematics club may also be taken in to consideration as variable.
- A comparative study of the functioning of the mathematics clubs in colleges of education in different states may be taken up.
- A comparative study of the functioning of the mathematics clubs in colleges of education and in its cooperating schools may be taken up.
- The impact of participation in a mathematics club as a teacher trainee in his regular teaching activity may be taken up.
- A case study of mathematics club may be taken up.

5.18. CONCLUSION

Journey towards perfection in mathematics education is a necessity for a developing country. The place of ***co-curricular activities in mathematics*** is not at all debatable. New dimensions and strategies shall be evolved for framing and implementing newer co-curricular activities in mathematics.

The study infers that co-curricular activities in mathematics are to be made integral part of mathematics education. In present system of education, yearend examinations are dominating all other activities in education system. Not only parents, but also teachers are giving zenith priority to marks or ranks in yearend or board examinations.

In this process they are ignoring the all round development of the pupils. So, as a result students are getting back from schools only with ranks and marks but not with sense and essence of real education. This in due course affects the development of the country.

Very few schools / teachers are thinking about co-curricular activities in mathematics. And again, very few out of these schools / teachers are organizing mathematics clubs. It indicates that many interdependent reasons are pulling back the passionate teachers. Another depressing thing is that, teachers in Government sector are very poor in organizing co-curricular activities in mathematics. But, in general view, they are more qualified, trained and proficient in all most all the corners of school education. Contrary to this, the present study reveals that teachers working in Government schools are in less rank than private school teachers regarding conduct of co-curricular activities in mathematics.

The study reveals how various demographic factors like – type of school, sex, experience of the teacher affects the conduct of co-curricular activities in mathematics. The study gives some results which are generally against some common beliefs.

The study suggest that, awareness programmes are needed to encourage more teachers towards making co-curricular activities in mathematics as a part of their regular class room teaching. Also, there is a need to popularize emerging trends in mathematics subject also to ease the inherent serious nature of the subjects and provide pleasant learning experiences. Apart from government schools and statutory glands, schools are to be encouraged to generate separate help from local organizations and general public.

The study opens some more areas like case study of mathematics clubs, comparative study of mathematics club in secondary schools and colleges of education affect on achievement of students for further study.

BIBLIOGRAPHY

A) BOOKS

1. Annice, John Williams. (1956). *Organizing a mathematics club.* Mathematics Teacher: 49, 149-150.
2. Best, J.W. & Kahn, J.V. (1995). *Research in Education*. New Delhi: Prentice Hall of India Pvt limited.
3. Butler, Ch. & Wren, F.L. (1960). *The teaching of Secondary mathematics.* New Delhi: Mc. Graw Hill Book Company.
4. Crawford, C.C. In Aggarwal, J.C. (1975). *Educational Research-An Introduction.* New Delhi: Arya Book Depot.
5. Dolton, L.C. & Synder, H.D. (1993). *Topics for mathematics club.* New Delhi: Mathematical Association of India.
6. Dewey, J. (1902). *The Child and the Curriculum*. Chicago: University of Chicago press.
7. Gaiand, & Sharma, (1973). *Educational Theories and Modern trends*. Agra: Ram Prasad Sons.
8. Garrett, H.E. (1981). *Statistics in Psychology and Education.* Bombay: Vakils, Feffer and Simons Ltd.
9. Gill & Sharma. (1989). *Teaching of mathematics.* Ludhiyana: M.T. Publications.
10. Good, C. V., Barr, A.S. & Scates, D. E. In Aggarwal, J.C. (1975). *Educational Research- An Introduction*. New Delhi: Arya Book Depot.
11. Guilford (1952). In Noor Asma, (2004). *Creativity of B.Ed Teacher Trainees*. New Delhi: Discovery Publishing House.
12. Kapur, J.N. (1967). *Some aspects of mathematics education in India.* New Delhi: Arya Book Depot.
13. Madurai Kamaraj University. (1997). *Reading Material B.Ed (Correspondence course).* Madurai.
14. Martz. In Aggarwal, J.C. (1975). *Educational Research-An Introduction.* New Delhi: Arya Book Depot.
15. Mouli, G.J. (1964). In Aggarwal, J.C. (1975). *Educational Research-An Introduction.* New Delhi: Arya Book Depot.

16. Sastry, D.S.N. (2000). *Content and methodology of teaching Mathematics. (D.I.E.T).* Vijayawada: Victory Publications.
17. Sastry, D.S.N. (2002). *Methods of teaching Mathematics.* Machilipatnam: Surya Publications.
18. Sastry, D.S.N. (2002). *Ganitam-Bodhana Padhatulu.* Hyderabad: Telugu Academy.
19. Sidhu, K. S. (2000). *The Teaching of Mathematics.* New Delhi: Sterling Publishers Private Limited.
20. Srinivasan, P.K. (1981). *The teaching of mathematics.* Bombay: Blackie and sons.
21. Srinivasan, P.K. (1981). *Why maths club.* Bombay: Blackie and sons.
22. Suryanarayana Duvvuri & et al (2005). Methods of teaching mathematics. Machilipatnam: Surya Publications.
23. Travers, Robert M.W. (1978). *An Introduction to Educational Research.* New York: Macmillan Publishing Co., Inc.

B) SURVEYS / DICTIONARIES / ENCYCLOPEDIAS / POLICIES

24. *The Second Survey of Research in Education*. (1979). Buch, M.B. (Ed). N.C.E.R.T., New Delhi.
25. *The Third Survey of Research in Education*. (1987). Buch, M.B. (Ed). N.C.E.R.T., New Delhi.
26. *The Fourth Survey of Research in Education*. (1991). Buch, M.B. (Ed). N.C.E.R.T., New Delhi.
27. *Dictionary of Education.* (1959). Good, C.V. (Ed), New York: Mc Graw Hill Book Co.
28. In service Teacher education package- Vol II (1987). Government of India Document, New Delhi.
29. Manuel, (1974, 1979). In Seshadri, C. (2006). Philosophy of Education. *Sixth Survey of Educational Research*. Vol 1, 1993-2005, N.C.E.R.T., New Delhi.
30. *National Policy on Education.* (1986). Government of India Document, New Delhi.

31. *National Curriculum Frame work.* (2005). Government of India Document, New Delhi.
32. *Natesan, N. (2001).* Journal of Educational Research and Extension, Vol. 38. No.1.
33. *National Focus group on teaching Mathematics.* (2006). Government of India Document, New Delhi.

C) JOURNALS / PERIODICALS / DOCUMENTS / PROCEEDINGS

34. Alimelu,K. (1999).Setting up mathematics laboratory. *The Mathematics Teacher* (India), Vol. 29, Issue 3&4, 1999, 37-41.
35. Balka, D.S. (1974). Creative Ability in Mathematics. *The Arithmetic Teacher*. 21(7), 633-663.
36. Bhatnagar, P.L. (1970, Nov-Dec). Presidential address in V Annual Conference of the Association of Mathematics Teachers of India. *The Mathematics Teacher* (India), Vol VII, No 2, AMTI.
37. Heck,E. (1999). Inaugural address at the ilver jubilee conference. *The Mathematics Teacher* (India), Vol. 29, Issue 3&4, 1999, 61-64.
38. *In service teacher education package (1988).* N.C.E.R.T., New Delhi, Vol II.
39. Malathi.K.N. (1999). The place of recreational mathematics in teaching and learning. *The Mathematics Teacher* (India), Vol. 29, Issue 3&4, 1999, 13-19
40. *National Curriculum Frame Work for School Education*. (2000). In Suraj Kumari (2002, May). On Linking Mathematics Education with Life Skills. *Journal of Indian Education.* N.C.E.R.T., New Delhi, Vol XXVIII, 69-76.
41. Padmakar M. Sapre (2002). Research and Teacher Education. *C.T.E. Journal*.
42. Sastry, D.S.N. (2008). Mathematical Problems - Related Abilities - Role of the Teacher. *The Mathematics Teacher* (India), Vol. 44, Issue 3&4, 2008.
43. Review. *Indian Educational Review.* Vol 39, No 2, N.C.E.R.T., New Delhi.
44. Srinivasan, P.K. (1974). Report on Group Discussions-Creativity in Mathematics Teaching. *The Mathematics Teacher (India)*. 10 (1974), 118-126.
45. Srinivasan, P.K. (1972). Organization of mathematics club (Quiz programme). *The Mathematics Teacher* (India), 1972, 34-37.

46. Srinivasan, P.K. (1973). Mathematics club activities (Bulletin board). *The Mathematics Teacher* (India), 1973, 85-87.

47. Srinivasan, P.K. (1973). Mathematics through club activities. *The Mathematics Teacher* (India), Vol. 9, 1973, 187-188.

48. Srinivasan, P.K. (1999). Stop the cultural alienation of mathematics. *The Mathematics Teacher* (India), Vol. 29, Issue 3&4, 1999, 31-35

D) UN PUBLISHED DISSERTATIONS / THESES

49. Almeqdadi, Farouq (1991). *The Effect of Using the Geometer's Sketchpad (G.S.P.) on Jordanian Students' Understanding Some Geometrical Concepts.*

50. Amulya Ratnamu, D. (1998). *Performance of Secondary school children in Achievement tests and Cross worf puzzle- A comparative study.* M.Ed. Dissertation, Acharya Nagarjuna University.

51. Bagga, D. (1973). In Subrahmanyam, A. (2004). *A Study of Mathematical Problem Creating Ability of Prospective Mathematics Teachers.* M.Ed. Dissertation, Acharya Nagarjuna University.

52. Bhatnagar, M.A. (2002) *A Depth Study of Co – Curricular Activities based Programme in Selected Institutions of Lucknow.* Ph.D. (Edu.), University of Lucknow.

53. Bayles (1971). In Sesha Rao, K. (2000). *A Study of Problem Creating Ability of Prospective Mathematics Teachers in Relation to their Philosophic Beliefs in Education.* M.Ed. Dissertation, Acharya Nagarjuna University.

54. *Carboni and Susan N. Friel (1996)* In Salara, D. (2002). *A critical study of the functioning of mathematics clubs in colleges of education in Andhra Pradesh* M.Ed dissertation, *Acharya* Nagarjuna University.

55. Murali Krishna, V. Lanka (2004). *A comparative study of performance of IX class students on achievement test and a cross word puzzle in mathematics.* M.Phil dissertation, Acharya Nagarjuna University.

56. Narasimha Rao, B.V.L. (1997). *A study of attitude of secondary school children to wards mathematics fairs.* M.Phil dissertation, Madurai Kamaraj University.

57. Salara, D. (2002). *A critical study of the functioning of mathematics clubs in colleges of education in Andhra Pradesh* M.Ed dissertation, *Acharya* Nagarjuna University.

58. Shakila, J. (2000). *A study of participation of IX class students in co-curricular activities of mathematics in Guntur city.* M.Ed dissertation, Acharya Nagarjuna University.

59. Surya Narayana Murthy, T.S.V.S. (2005). *Performance of VIII class students in mathematics on an achievement test and a cross word puzzle- a comparative study.* M.Phil dissertation, Madurai Kamaraj University.

E) WEB SITES

60. A Guide for writing Research Papers, APA – Style, Retrieved, March11, 2009, from www.apa.org.

61. Hollingsworth (1989), Onwuegbuzie, A.J. & Witcher, *A.E. (2002). Changes in Teacher Candidates' Beliefs about Education.* Retrieved, March 10, 2008, from http:// rapidintellect.com/ AEQ Web/ fa102.htm

62. *National Center for Education Statistics.* (2005). Education Statistics Quarterly, 6,12.Retrieved,February9,2008,fromhttp://nces.ed.gov/programs/quarterly/vol_6/1_2/5_1.asp

63. Sheffield, L.J. (2005). *Using Creative Techniques to add Depth and Complexity to the Mathematics curricula.* Retrieved, February 9, 2008, from http:// math.ecnu.cdu.cn/earcome3/sym1/EARCOME3- Sheffield - Linda - Sym1. doc

ACHARYA NAGARJUNA UNIVERSITY

NAGARJUNA NAGAR

TOPIC: A Study of the Organization of Mathematical Co-Curricular Activities in Secondary Schools

APPEAL

The following Check list is issued to collect data pertaining to co curricular activities in Mathematics as a part of research work. You are requested to express your agreement or disagreement with each statement. Please put a tick (✓) mark against each statement in the space provided, if that activity is taken by you. Please tender your frank and honest response on all the statements. The information supplied by you will be kept confidential and utilized for academic purpose only.

Your whole hearted cooperation is earnestly solicited.

Research Guide:
Dr.Smt.G.Bhuvaneswara Lakshmi,
Principal, M.M. College of Education, Vijayawada

Yours Sincerely,
(K.Rama Krishna)

PART-A

Name and address of the school:

Existence of Mathematics club:	Yes / No
Type of Management:	Govt/Municipal/Pvt.Aided/Pvt.unaided
Sex of the in-charge of the club/activities:	Male / Female
Teaching experience (in years):	Less than 5/5-10/10-15/15-20/above 20
Experience as in charge:	Less than 5/5-10/10-15/15-20/above 20

PART- B

Please put a tick (✓) mark against each statement in the space provided, if that activity is taken by you.

Activities taken by the Teacher

67. Preparation of Teaching – Learning models by Teachers ( )
68. Display/Demonstration of the models in the school ( )
69. Maths Project works undertaken ( )
70. Participation in Maths fairs out side the school ( )
71. Using computers for Teaching Learning Material in Maths ( )
    If Yes, Please specify the activity----------
72. Conduct of Maths quiz to the class students only ( )
73. Conduct of Maths quiz on special occasions ( )
74. Conduct of Maths quiz for local schools ( )
75. Administering Maths cross word puzzles ( )
76. Administering Maths word search ( )
77. Arranging Ganitha 'Asthavadhanams' ( )
78. Demonstration of speed Mathematics techniques by staff ( )
79. Lectures by eminent persons on Maths history/culture/utility ( )
80. Special classes for students by Resource persons on Maths related things ( )
81. Conduct of Work shops/orientation classes for the faculty members ( )
82. Conduct of Work shops/orientation classes for local students ( )
83. Exposing students to Radio lessons in Mathematics ( )
84. Radio Lessons with students on Maths ( )
85. Exposing students to Tele school programmes in Mathematics ( )
86. Exposing students to Mana T.V. programmes in Mathematics ( )
87. Collection of material for Maths talent tests & Olympiads ( )
88. Encouraging students to write Maths articles to School magazine ( )
89. Encouraging students to write Maths articles to other magazines ( )
90. Collection of reference material from Journals subscribed by the School ( )
    The Mathematics Teacher (Chennai) Mathematics to Day (New Delhi)
    Ganitha Chandrika (Vijayawada) Ganitha Vaahini (Ramachandrapuram)
91. Conducting maths exhibition as a part of school science exhibition ( )
92. Conducting separate maths exhibitions in the school ( )

Activities taken by Students

93. Preparation of Teaching – Learning models by Students ( )
94. Participation in Maths fairs out side the school ( )
95. Maintaining a bulletin board ( )
96. Participation in Maths quiz conducted by other agencies ( )
97. Maths Project works undertaken ( )
98. Demonstration of speed Mathematics techniques by students ( )
99. Collection of material for Maths talent tests & Olympiads ( )
100. Collection of Maths related News paper cuttings ( )
101. Preparation of scrape books ( )
102. Display of paper cuttings and photos on charts ( )
103. Preparation of Script magazine in Maths ( )
104. Maintenance of wall magazine in Maths ( )
105. Contributing Mathematics related books to the school ( )
106. Writing Maths related things or completing puzzles in papers ( )
107. Collection of reference material from Journals ( )

The Mathematics Teacher (Chennai) Mathematics to Day (New Delhi)
Ganitha Chandrika (Vijayawada) Ganitha Vaahini (Ramachandrapuram)

Activities taken by both Teachers and Students

108. Participation in Maths fairs out side the school ( )
109. Celebration of Birth days /death anniversaries of Mathematicians ( )
110. Celebrating important occasions in Mathematics ( )
Inter National Maths Year-2000; Inter National Maths Day-Aug, 22;
National Maths Day-Dec 22
111. Special emphasis on Indian Mathematics at School level ( )
112. Cultural programmes relating to Maths in the form of Play lets etc ( )
113. Please specify, if any other……..

PART- C

Please put a tick (✓) mark against each statement in the space provided, if that activity is taken by you.

Encouragement to Activities

Financial

114.	Support from management	( )
115.	Funds from special fee	( )
116.	Contribution from staff members	( )
117.	Contribution from students voluntary	( )
118.	Contribution from old students/parents	( )
119.	From any sponsoring agency/donors	( )
120.	support from local Maths associations	( )
121.	support from local school	( )
122.	collection of separate fee from students	( )

Academic

123.	Staff members	( )
124.	Local Maths associations	( )
125.	Local schools	( )
126.	Resource persons	( )

Infrastructural facilities

127.	Separate room	( )
128.	Stationary	( )
129.	power supply	( )
130.	Computers	( )
131.	Internet	
132.	Preservation facilities for the models in the school	( )
133.	Please specify, if any other	